POLLUTIONAL CHARACTERISTICS OF KAM-KOTIA MINES LIMITED

ROBB TOWNSHIP

An abandoned base metal mine-mill complex

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MINE TECH.

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Ontario

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Director
Northeastern Region

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MINISTRY OF THE ENVIRONMENT

POLLUTIONAL CHARACTERISTICS

OF

KAM-KOTIA MINES LIMITED

ROBB TOWNSHIP

AN ABANDONED BASE METAL MINE-MILL COMPLEX

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SUMMER STUDENT - 1976

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SUMMARY AND CONCLUSIONS

The abandoned Kam-Kotia mine-mill complex has caused impairment of the local area in the vicinity of the mine and river system including:

(a) changes in the aquatic chemistry,
(b) a change in water colour

The study has shown an increase in metal ion concentration; exceptionally high levels of dissolved solids, particularly sulphates; and pH depression (See appendix) in the aquatic environment.

The impairment of the aquatic environment (both north and south Kamiskotia Creeks) by excessive levels of contaminants far above the levels detected in the 1971 survey is noted (The degree of pollution of the seepages at the point of exit (north-south dyke) from the contained tailings (136 acres) are moderately high; however, as the discharge migrates over the uncontained tailings (322 acres) towards Kamiskotia River, the level of metals etc. is exceptionally elevated compared to the former).

Summarily, this study has demonstrated the need for major improvements in the methods of treating wastes from the abandoned mine-mill complex of Kam-Kotia Mines Limited.

In order to prevent any further degradation of the property, the following actions are recommended:

1) Control seepages from the contained tailings area (136) acres) especially along the north-south dyke. As acid generation is quite evident, proper containement of the seepage flows must be implemented and all flows must be directed to one location for neutralization.

2) Implementation of a comprehensive program to stabilize all non-contained tailings and direct all seepage flows to a central location for neutralization techniques; if required.

3) A program to divert all ponding of surface water from the waste water discharge area (82 acres). (Early Tailings Discharge).

4) Diversion ditches should be constructed (to treat wastes) around the perimeters of the waste rock storage areas to confine seepage wastes.

5) Immediately implement a detailed monitoring program for all effluents leaving the impounded area (north-south dyke and east-west dyke), the unimpounded area, and the waste water discharge area. (Early Tailings Discharge).

6) If point number one (1) is initiated, it will still be necessary to control seepages from the unimpounded area (322 acres) so that further contamination of Kamiskotia River will cease.

INTRODUCTION

It has become quite apparent, that large quantities of effluent wastes result from base metal mining. Today, it is estimated that mine drainage contributes to thousands of tons of acid pollution to many hundreds of miles of waterways in Canada. Acid drainage (see appendix) enters our streams and lakes, destroying fish, fish food organisms, and wildlife. Acid mine water is associated with surface and underground mining operations (about half the acid production comes from abandoned mines; the rest from operating mines).

Sulphur bearing minerals (FeS_2) mix with air (O_2) and water (H_2O) to form sulphuric acid (H_2SO_4). The result from mining operations is a low pH effluent containing a ferric ion. The problem is initiated when the pH of the effluent rises above 3.0 or so; the ion becomes unstable and precipitates as the hydrated oxide (sulphuric acid is released during this reaction). The seepage, once the reaction has started, exhibits general acid characteristics (low pH; elevated metal ion content; and an extremely high level of sulphate ions) and may continue for years on a property without treatment.

SCOPE

An extensive study was conducted in August and September of 1975, by the Industrial Abatement Section of the Ontario Ministry of the Environment, to update an environmental report (Report on An Industrial Wastes Survey of Kam-Kotia Mines Limited, Township of Robb and Jameland Mines Limited, Township of Jamieson - July 1971), on the treatment and disposal of mining wastes, and to compare analytical data from the area, now that the mine has ceased operation.

GENERAL INFORMATION - KAM-KOTIA MINES LIMITED

3.1 LOCATION

The abandoned base metal Kam-Kotia Mine is located 14.5 kilometres (HWY #576) in a north-westerly direction from the City of Timmins in the Township of Robb. The topography of the area surrounding the complex is fairly level with very poor drainage. Runoff is generally towards a north-easterly direction feeding the Kamiskotia River (flows to the Mattagami River) and in a south-easterly direction towards Little Kamiskotia River (flows from Kamiskotia Lake) which eventually feeds the Mattagami River.

3.2 ATMOSPHERIC CONDITIONS

During the Kam-Kotia Mine study, very little precipitation fell as noted in Table 1. The temperatures during July and August were extremely high; thus, accelerating evaporation in the general area. A noticable decrease in water levels of the streams, and rivers were caused by the exceptionally dry summer that was experienced in the area in 1975.

3.3 TAILINGS

The most recent deposition of tailings (high pyrrhotite content with 1% pyrite, 0.12% copper, and 0.55% zinc) from the Kam-Kotia Mine is in a northerly direction. The tailings areas will be designated in the following way throughout this report.

(a) Present impounded tailings - 136 acres
(b) Old tailings (not impounded) - 322 acres
(c) Waste water discharge - 82 acres.
(Early Tailing Discharge)

Originally in the 1940's to 1961, a company called Wartime Metal Corporation spilled approximately 0.1 - 0.3 x 10^6 tons of tailings north of the mill. When the company dissolved and Kam-Kotia Mines Limited acquired the property, 0.3 x 10^6 tons of tailings were deposited in the same location for a one year period.

For a five year period up to 1967, Kam-Kotia Mines discharged 3.0 x 10^6 tons of tailings in a northerly direction from the mill and because of a need for proper contaminant (tailings south of the mill were migrating towards Little Kamiskotia River and the recently deposited tailings migrating towards Kamiskotia River) of the northern spill area (major), an abandoned open pit was utilized (1.2 - 1.6 x 10^6 tons of tailings) as an interim measure while an impounded area was constructed north of the mill (the impoundment area probably held about 50% of the original 3.0 x 10^6 tons of tailings).

Correction on Page (4) of the

POLLUTIONAL CHARACTERISTICS OF KAM-KOTIA MINES LIMITED, ROBB TOWNSHIP

An abandoned base metal mine mill complex.

The fourth last word of the first sentence should read north not south and the last sentence regarding the deposition of tailings should indicate a southerly direction from the mine-mill complex.

TABLE I

PRECIPITATION DURING SURVEY OF KAM-KOTIA

DATE	TOTAL AMOUNT OF PRECIPITATION IN MILLIMETRES
September 1	.3
" 2	0.0
" 3	0.0
" 4	0.0
" 5	0.0
" 6	6.6
" 7	10.4
" 8	21.1
" 9	0.0
" 10	1.0
" 11	10.9
" 12	1.5
" 13	0.5
" 14	0.5
" 15	1.8
" 16	5.1
" 17	0.0
" 18	0.0
" 19	17.8
" 20	8.9
" 21	0.5
" 22	0.0
" 23	0.0
" 24	0.0
" 25	0.0
" 26	0.0
" 27	0.0
" 28	0.0
" 29	0.0
" 30	0.0

TOTAL PRECIPITATION FOR MONTH OF SEPTEMBER 1975 - 86.9 M.M.
(Only A Trace Amount of Snow).

FIGURE I

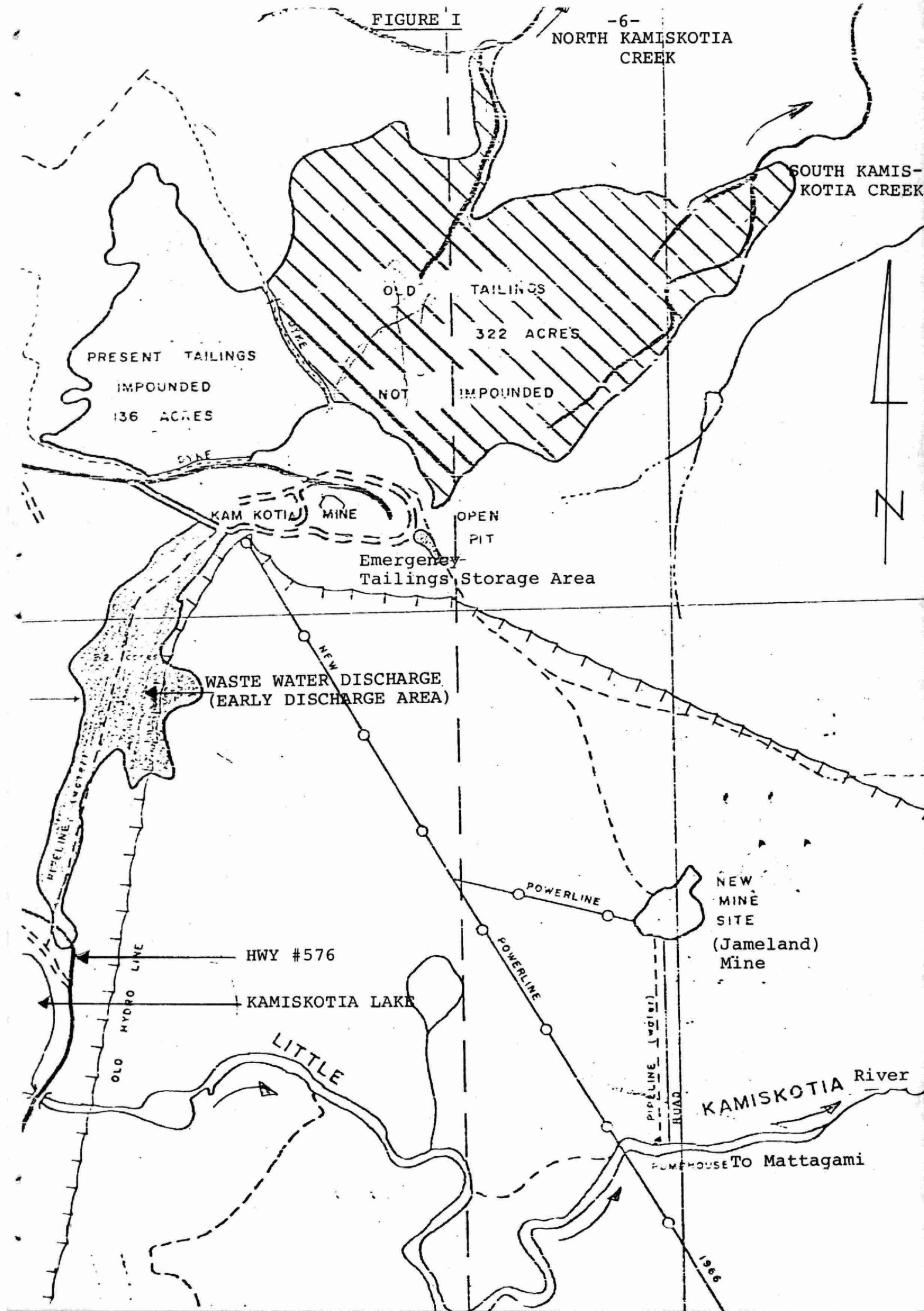
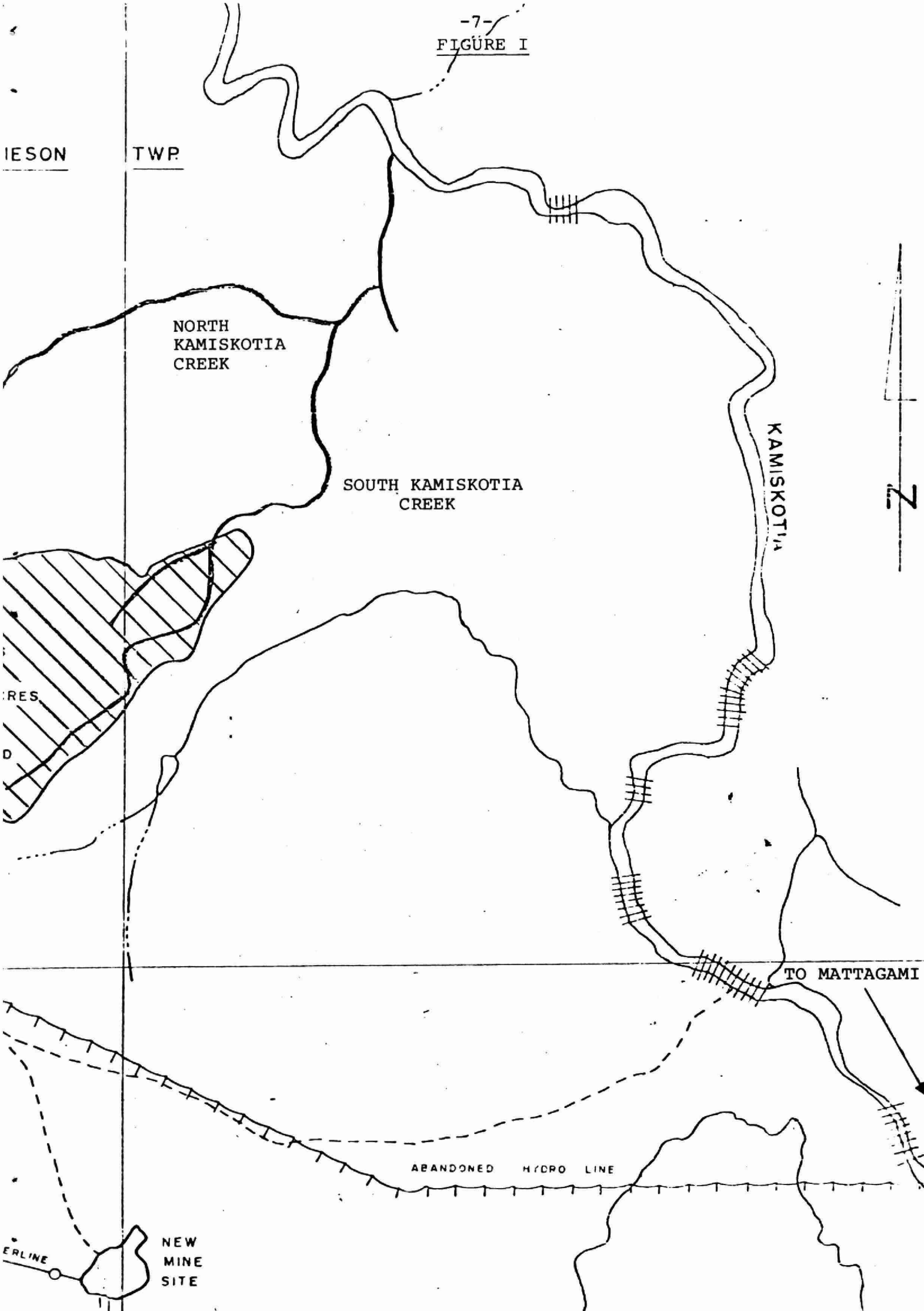

NORTH KAMISKOTIA CREEK
SOUTH KAMIS-KOTIA CREEK
OLD TAILINGS
322 ACRES
NOT IMPOUNDED
DYKE
PRESENT TAILINGS
IMPOUNDED
136 ACRES
DYKE
KAM KOTIA MINE
OPEN PIT
Emergency Tailings Storage Area
N
NEW
WASTE WATER DISCHARGE
(EARLY DISCHARGE AREA)
PIPELINE (WATER)
POWERLINE
NEW MINE SITE
(Jameland) Mine
HWY #576
OLD HYDRO LINE
KAMISKOTIA LAKE
POWERLINE
LITTLE
PIPELINE (WATER)
ROAD
KAMISKOTIA River
POWERHOUSE
To Mattagami
1966

FIGURE I


IESON
TWP.
NORTH
KAMISKOTIA
CREEK
SOUTH KAMISKOTIA
CREEK
KAMISKOTIA
RES
D
TO MATTAGAMI
ABANDONED HYDRO LINE
NEW
MINE
SITE
ERLINE
N

3.4 PREVIOUS MINING AND MILLING RATES

At the end of 1972 (cessation of mining), the mine-mill complex was reported to have the following rates of production:

Kam-Kotia Mine and Jameland Mine
Production - 1800 Tons/Day

Kam-Kotia Mill Production
- 1800 Tons/Day

Quantity of Tailings Deposited
- 1650 Tons/Day

Concentrate Producted (Zn and Cu)
150 Tons/Day

TABLE II

3.5 BULK REAGENTS - KAM-KOTIA MILL

The following reagents were used at the Kam-Kotia mill complex.

REAGENT	PURPOSE	QUANTITY
Slacked Lime $Ca(OH)_2$	Slime Conditioner and pyrite depressor	3.864 lbs/ton
Potassium Amyl Xanthate $C_5H_{11}OCS_2K$	Zinc and Copper collector in flotation circuit	0.193 lbs/ton
Zinc Sulphate $ZnSO_4$	Depressor of Zinc Sulphide ZnS	0.153 lbs/ton
Copper Sulphate $CuSO_4$	Activator for Zinc Sulphide ZnS	0.899 lbs/ton
2- Methyl - 1 Pentanol MIBC	Frother (flotation circuit)	0.210 lbs/ton
Sodium Cyanide NaCN	Pyrite Depressant	0.006 lbs/ton

3.6 OWNERSHIP

At the present time, the Kam-Kotia Mines Ltd. claims are held by Robison Mines Ltd., which is 60% controlled by Cominco Mines Ltd., and 40% by the Kam-Kotia Group.

Clarification of whether the claims, underlying the Kam-Kotia tailings, will be turned over to Kam-Kotia Mines Ltd., or whether Robison Mines Ltd. will take ownership, will be known in 1976.

3.7 DESCRIPTION OF THE PAST PROCESS

The ore from underground was directed to primary and secondary cone crushers, located in the mill. This part of the milling was conducted in a dry environment.

Ore from the cone crushers was sent to a series of ball mills in closed circuit (a classifier and ball mill are operated together as to control, to some extent, the fine grind in preparation for the floatation step) where cyanide and lime were added to condition the ore before it enters the floatation circuit.

The slurry was introduced to the copper floatation circuit (In floatation equipment, the ore is suspended in water at a pulp density generally from 15 to 35 weight per cent solids by means of mechanical or air agitation. The surfaces of specific mineral particles are treated with promoters or collectors (in this case, Amyl Xanthate $C_5H_{11}OCS_2K$) which renders those particles air-avid and water-repellent. With vigorous agitation and aeration in the presence of a frother (Methyl Isobutyl Carbinol -

(CH_3) $C_5H_{10}OH$), a layer of froth or foam forms at the top of the floatation circuit. The air-avid minerals become attached to air bubbles and rise to the surface where they collect in the froth and are skimmed off. The undesired minerals are depressed or rendered non-floatable either by leaving their surfaces unaltered by collector adsorption or through the use of modifying agents) where it was floated, thickened, and filtered, while the underflow (still containing the zinc), was conveyed to the zinc floatation circuit where it was floated, thickened and dried. The underflow from the zinc circuit was directed to the tailings area.

The final tailings (slurried) often contain sulphides on the average of 40-50 percent. The sulphides in turn, were essentially all pyrrhotite with 1 percent pyrite, 0.12 percent and 0.55 percent copper sulphide and zinc sulphide, respectively.

METHODOLOGY IN SAMPLING AND ELEMENTS DETERMINED

A comprehensive study was conducted in August and September 1975, to up-date a previous survey on the treatment and disposal of mining wastes, and to compare analytical water data from the area; now that the mine has ceased operation.

Water samples and solid samples (not in this report) were collected at different locations in the area of the mine-mill complex. At each location 1 - litre samples in glass bottles and 1 - litre samples in polyethylene bottles were collected for analyses at the Ministry of the Environment's Rexdale Laboratory. The samples collected in polyethylene bottles were acidified with sufficient nitric acid (HNO_3) to reduce the pH to less than 3.0 in order to prevent metallic ions from precipitating out of solution (for cyanide analyses sodium hydroxide (NaOH) was used to hold the cyanide ion in solution).

4.1 SUMMARY OF CHEMICAL ANALYSES PERFORMED ON SAMPLES FROM THE KAM-KOTIA MINE SURVEY 1971

Total Solids

Suspended Solids

Dissolved Solids

Sulphate as (SO_4)

Free Ammonia as (NH_3)

Total Kjeldahl Nitrogen

Nitrate (NO_3)

Nitrite (NO_2)

Total Phosphorus as (P)

Total Iron as (Fe)

Copper as (Cu)

pH at Laboratory

Zinc as (Zn)

Cobalt as (Co)

Nickel as (Ni)

Aluminum as (Al)

Chloride as (Cl)

Manganese as (Mn)

Lead as (Pb)

Vanadium as (V)

Cadmium as (Cd)

Mercury as (Hg)

Tin as (Sn)

Titanium as (Ti)

Molybdenum as (Mo)

Barium as (Ba)

Lithium as (Li)

Sodium as (Na)

Potassium as (K)

Calcium as (Ca)

Arsenic as (As)

Magnesium as (Mg)

Acidity as ($CaCO_3$)

Alkalinity as ($CaCO_3$)

Hardness as ($CaCO_3$)

4.2 SUMMARY OF CHEMICAL ANALYSES PERFORMED ON SAMPLES FROM THE KAM-KOTIA MINE SURVEY 1975

Total Solids	Nickel as (Ni)
Suspended Solids	Chloride as (Cl)
Dissolved Solids	Manganese as (Mn)
Sulphates as (SO_4)	Lead as (Pb)
Free Ammonia as (NH_3)	Cadmium as (Cd)
Total Kjeldahl Nitrogen	Sodium as (Na)
Nitrate as (NO_3)	Potassium as (K)
Nitrite as (NO_2)	Calcium as (Ca)
Total Phosphorus as (P)	Arsenic as (As)
Total Iron as (Fe)	Magnesium as (Mg)
Copper as (Cu)	Acidity as ($CaCO_3$)
pH at Laboratory	Alkalinity as ($CaCO_3$)
Zinc as (Zn)	Hardness as ($CaCO_3$)
Cobalt as (Co)	Free $C\bar{N}$ as (HCN)

5. MINING AND MILLING EFFLUENT GUIDELINES

The objectives for controlling environmentally unacceptable material in mine-mill effluents, which are applied at the point of discharge, are summarized as follows:

5.1 METALS

Total concentrations of any individual metal * (excluding magnesium, calcium, potassium and sodium) in an effluent should not exceed 1 ug/ml. unless otherwise indicated. **

** At any mining location, mercury, and cadmium should not be discharged into the natural environment. If discharged the level of metals (cadmium and mercury) should not exeed the natural background concentration of the metals in question.*

*** More stringent mine-mill effluent guidelines could be taken for a certain property if the Ontario Ministry of the Environment should decide that such action be warranted.*

5.2 SULPHATES AND TOTAL DISSOLVED SOLIDS

Sulphates and total dissolved solids should be kept as low as possible in the effluent as to minimize the build-up of such compounds in the receiving waters.

5.3 AMMONIA

Concentration of ammonia in mine-mill effluents should be kept as low as present day technology permits. Until the technology for the removal of ammonia from waste water streams improves, the use of ammonia based compounds or ammonia by the mining industry should be minimized whenever and wherever possible.

5.4 SUSPENDED SOLIDS

Suspended solids has been set at 15 ug/ml concentration for mine-mill effluents.

5.5 pH

Mine-mill effluents must be maintained (at the point of discharge) within the range of 5.5 to 10.6. The pH should not be allowed to drop below 5.5

TABLE III

6. SUMMARY AND DESCRIPTION OF SAMPLING LOCATIONS (1971)

Location No.	Laboratory No.	Date	Comment
101	T28-207	July 13, 1971	- decant - flow estimated at 600 IGPM
102	T28-208	July 14, 1971	- flow estimated at 600 IGPM
103	T28-226	July 14, 1971	- Kam-Kotia Minewater discharge - flow - 200 IGPM
104	T28-204	July 13, 1971	- Jameland Minewater discharge - flow - 11,000 IGPD
105	T28-224	July 14, 1971	- Jameland minewater discharge - flow - 11,000 IGPD
106	T28-223	July 14, 1971	- Stream below Kam-Kotia minewater discharge
107	T28-221	July 14, 1971	- Stream below Jameland minewater dischage
108	T28-215	July 13, 1971	- Seepage pond deep red colour
109	T28-212	July 13, 1971	- Seepage flow - 10 IGPM - deep red
110	T28-211	July 13, 1971	- Seepage flow - 25 IGPM - deep red
111	T28-210	July 14, 1971	- Seepage pond deep red colour
112	T28-209	July 14, 1971	- Seepage pond light red colour
113	T28-222	July 14, 1971	- Seepage Flow - 15 GPM at Highway 576 culvert

SUMMARY AND DESCRIPTION OF SAMPLING LOCATIONS (1971) CON't

Location No.	Laboratory No.	Date	Comment
114	T28-214	July 13, 1971	- Kamiskotia Creek 0.5 kilometres upstream of Kamiskotia River
115	T28-203	July 13, 1971	- Kamiskotia Creek 1.2 kilometres downstream from decant
116	T28-217	July 14, 1971	- Ditch along Hwy. 576 -input into Little Kamiskotia River
117	T28-218	July 14, 1971	- Stream input into Little Kamiskotia River
118	T28-216	July 13, 1971	- Kamiskotia River about 0.8 kilometres upstream of Kamiskotia Creek
119	T28-219	July 13, 1971	- Kamiskotia River about 0.03 kilometres upstream of Kamiskotia Creek input
120	T28-220	July 13, 1971	- Kamiskotia River 0.8 kilometres downstream of Kamiskotia Creek input
121	T28-213	July 13, 1971	- Kamiskotia River 1.6 kilometres downstream of Kamiskotia Creek input
122	T29-18	July 14, 1971	- Little Kamiskotia River near Kamiskotia Lake outlet
123	T29-19	July 14, 1971	- Little Kamiskotia River about .4 kilometres downsteam from lake
124	T28-205	July 14, 1971	- Little Kamiskotia River about 2.0 kilometres downstream from lake
125	T28-206	July 14, 1971	- Little Kamiskotia River approximately 2.8 kilometres downstream from lake
126	T28-226	July 14, 1971	- Little Kamiskotia River downstream of company operations
127	T18-52	April 26,1972	- Kamiskotia Lake-flow via Hwy. 576 culvert
128	T18-54	April 26,1972	- Effluent into Little Kamiskotia River via Hwy. 576 ditch

TABLE IV

7. SUMMARY AND DESCRIPTION OF SAMPLING LOCATIONS (1975)

Location No.	Laboratory No.	Date Sampled	Locations and Comments
101	T37-54	Sept. 15/75	Effluent from impounded tailings area (taken at south-east corner of un-impounded area adjacent to rock face
102	T37-55	Sept. 15/75	Effluent near garbage dump approximately 0.4 kilometres from rock face. A continuation of sample #101
103	T37-56	Sept. 15/75	Effluent from rock face - location 0.8 kilometres from rock face. A continuation of samples #101, and #102
104	T37-57	Sept. 15/75	South Kamiskotia Creek A continuation of samples #101, #102, and #103.
110	T37-58	Sept. 15/75	Kam-Kotia decant 3:00 p.m.
101E	T37-59	Sept. 15/75	Liquid effluent from a 15.5 cm depth. Solid sample - same location as sample #101
200	T37-68	Sept. 15/75	Kamiskotia Lake at main wharf 1:30 p.m.
201	T37-69	Sept. 15/75	Mouth of Little Kamiskotia River 1:45 p.m.
202	T37-70	Sept. 15/75	Kamiskotia Lake at the mouth of Little Kamiskotia River 2:00 p.m.
203	T37-71	Sept. 15/75	Ditch beside Hwy 576 leading to Little Kamiskotia River
300	T38-15	Sept. 17/75	Seepage from impounded area 1.2 kilometres north-west of sample #101 (Deep red colour) 10:00 a.m.
301	T38-16	Sept. 17/75	Seepage from impounded area Sample #300 Approximately 0.8 kilometres away from sample #300(easterly direction-(Deep red-brown colour) 10:15 a.m.

SUMMARY AND DESCRIPTION OF SAMPLING LOCATIONS (1975) CON'T

Location No.	Laboratory No.	Date Sampled	Location and Comments
302	T-38-17	Sept. 17/75	Seepage from impounded area 0.4 kilometres south-east of sample #300 (very dark brown) 10:30 A.M.
303	T38-18	Sept. 17/75	Seepage from impounded area 0.8 kilometres south-east of sample #300 (light red in colour) 10:45 A.M.
400	T38-12	Sept. 17/75	North Kamiskotia Creek before joining Kamis-kotia River 10:45 A.M.
401	T38-13	Sept. 17/75	Continuation of sample #301 on unimpounded tailings (drainage) 11:00 A.M. 1.6 kilometres from sample #300
402	T38-14	Sept. 18/75	Continuation of samples #302 and #303 0.5 kilometres from impoundment dyke 11:15 A.M.
500	T38-32	Sept. 19/75	Marsh area at Jameland Mine Ltd. 10:05 A.M. -Field pH 6.5
501	T38-67	Sept. 22/75	Drainage from Mine water discharge area. 2:00 P.M. Field pH 3.5

TABLE V

8. COMPARISION OF SAMPLE LOCATIONS

1971		1975	
Location No.	Laboratory No.	Location No.	Laboratory No.
101	T28-207	110	T37-55
102	T28-208	110	T37-58
103	T28-226	No Discharge	
104	T28-204	No Discharge	
105	T28-224	No Discharge	
106	T28-223	501	T38-67
107	T28-221	Not Obtained	
108	T28-215	300	T38-15
109	T28-212	302	T38-17
110	T28-211	303	T38-18
111	T28-210	101	T37-54
112	T28-209	Not Obtained	
113	T28-222	Not Obtained	
114	T28-214	Not Obtained	
115	T28-203	400	T38-12
116	T28-217	203	T37-71
117	T28-218	Not Obtained	
118	T28-216	Not Obtained	
119	T28-219	Not Obtained	
120	T28-220	Not Obtained	
121	T28-213	Not Obtained	
122	T29-18	202	T37-70
123	T29-19	201	T37-69
124	T28-205	500	T38-32
125	T28-206	Not Obtained	
126	T28-226	Not Obtained	
127	T18-52	Not Obtained	
128	T18-54	203	T37-71

TABLE VI

9. SAMPLE LOCATIONS ADDED TO 1975 STUDY

Location No.	Laboratory No.	Date Sampled	Location & Comments
102	T37-55	Sept. 15/75	Continuation of sample #101, 0.4 kilometres from rock face (dyke)
103	T37-56	Sept. 15/75	Continuation of samples #101, and #102, 0.8 kilometres from rock face (dyke)
104	T37-57	Sept. 15/75	South Kamiskotia Creek Continuation of samples #101, #102, #103
101E	T37-59	Sept. 15/75	Liquid effluent from a 15.5 cm depth. Solid sample same location as #101
200	T37-68	Sept. 15/75	Kamiskotia Lake at main wharf 1:30 p.m.
301	T38-16	Sept. 17/75	Seepage from impounded area - sample #300 Approx. 0.8 kilometres away from #300 10:15 a.m.
401	T38-13	Sept. 18/75	Continuation of sample #301 on unimpounded tailings (drainage) 11:00 a.m.
402	T38-14	Sept. 18/75	Continuation of samples #302 and #303, 0.5 kilometres from rock face (dyke) 11:15 a.m.

FIGURE II

SAMPLE LOCATION - 1971 KAM-KOTIA MINES LTD

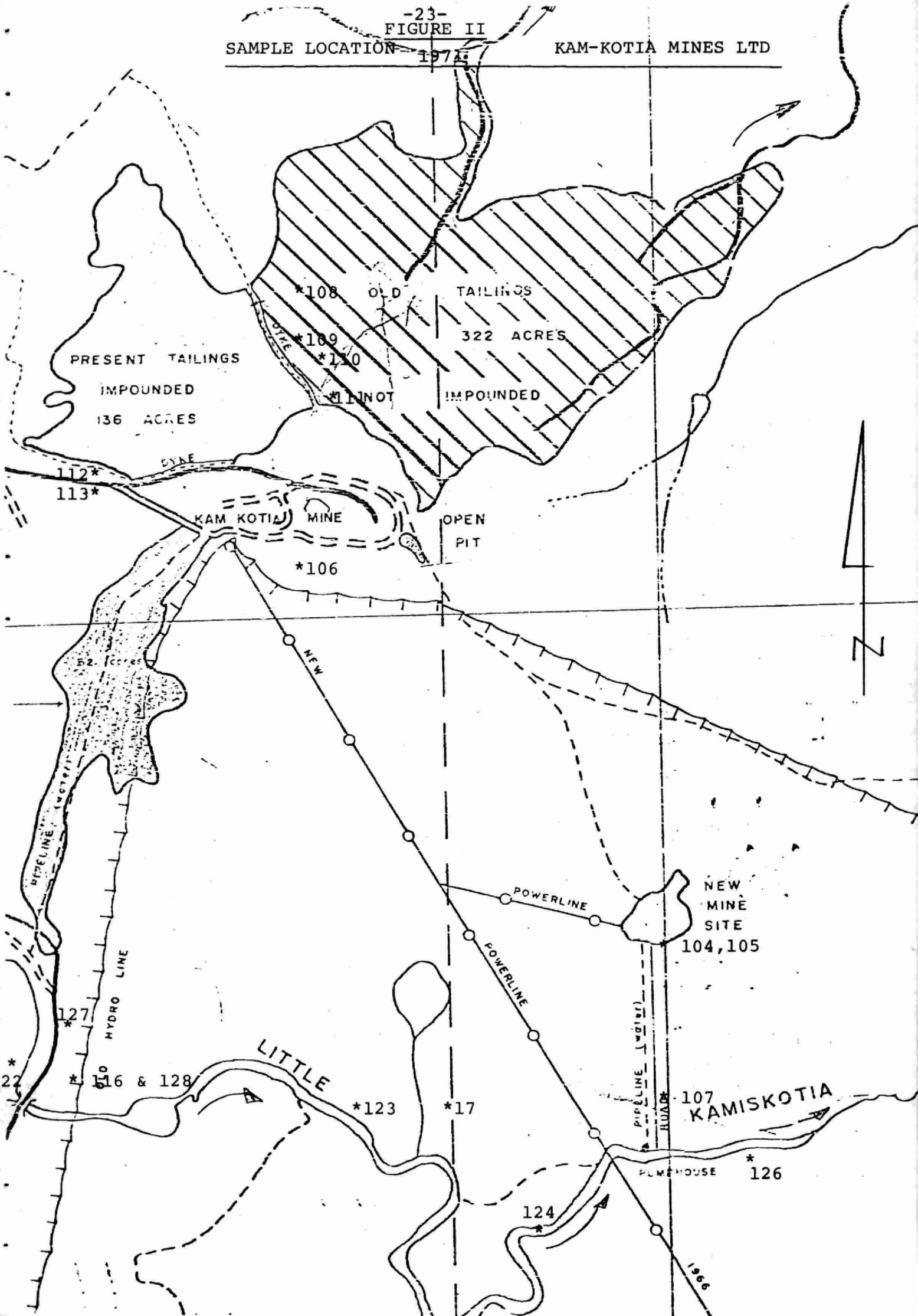


FIGURE II KAM-KOTIA MINES LTD.
SAMPLE LOCATIONS 1971 Con't

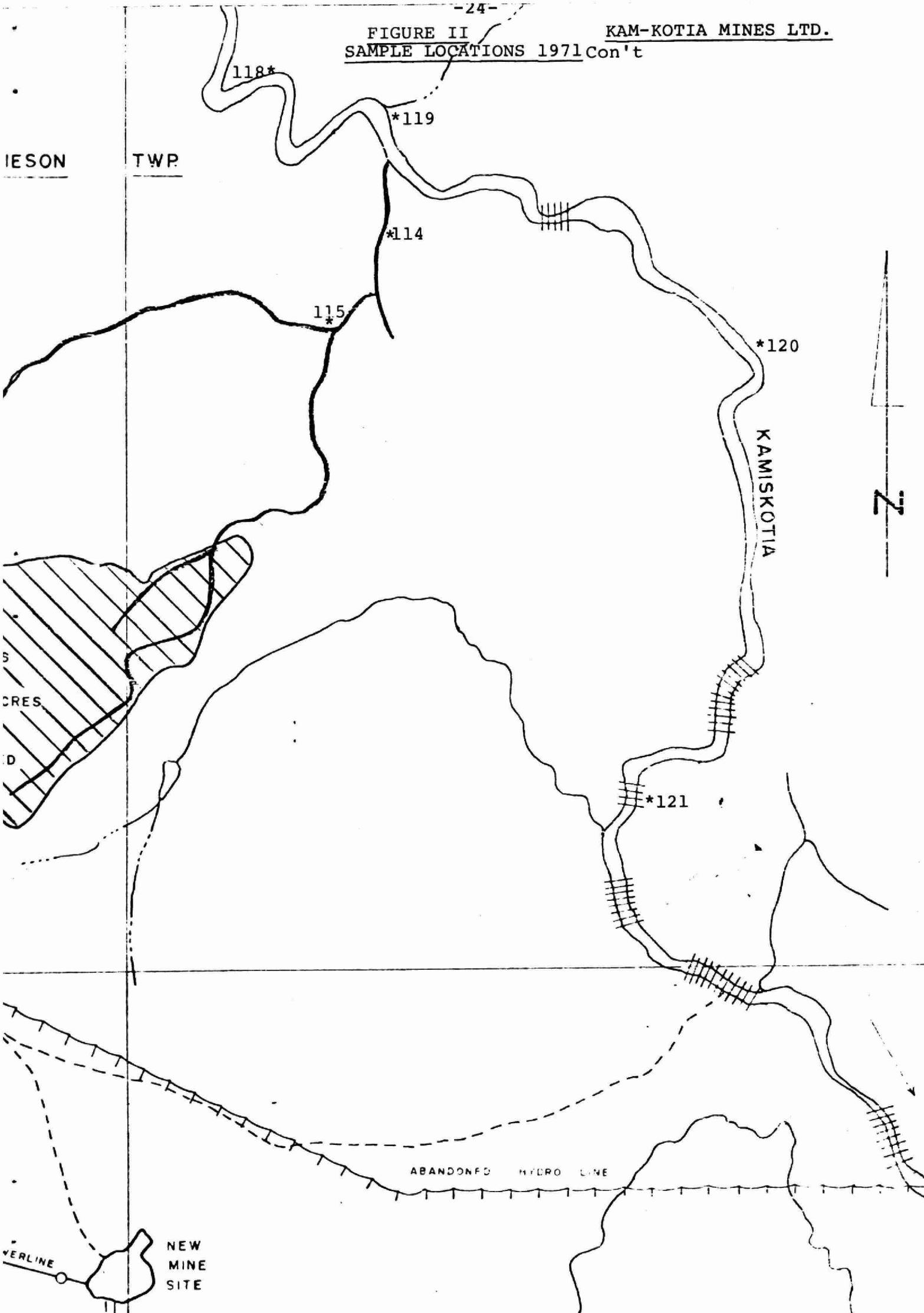
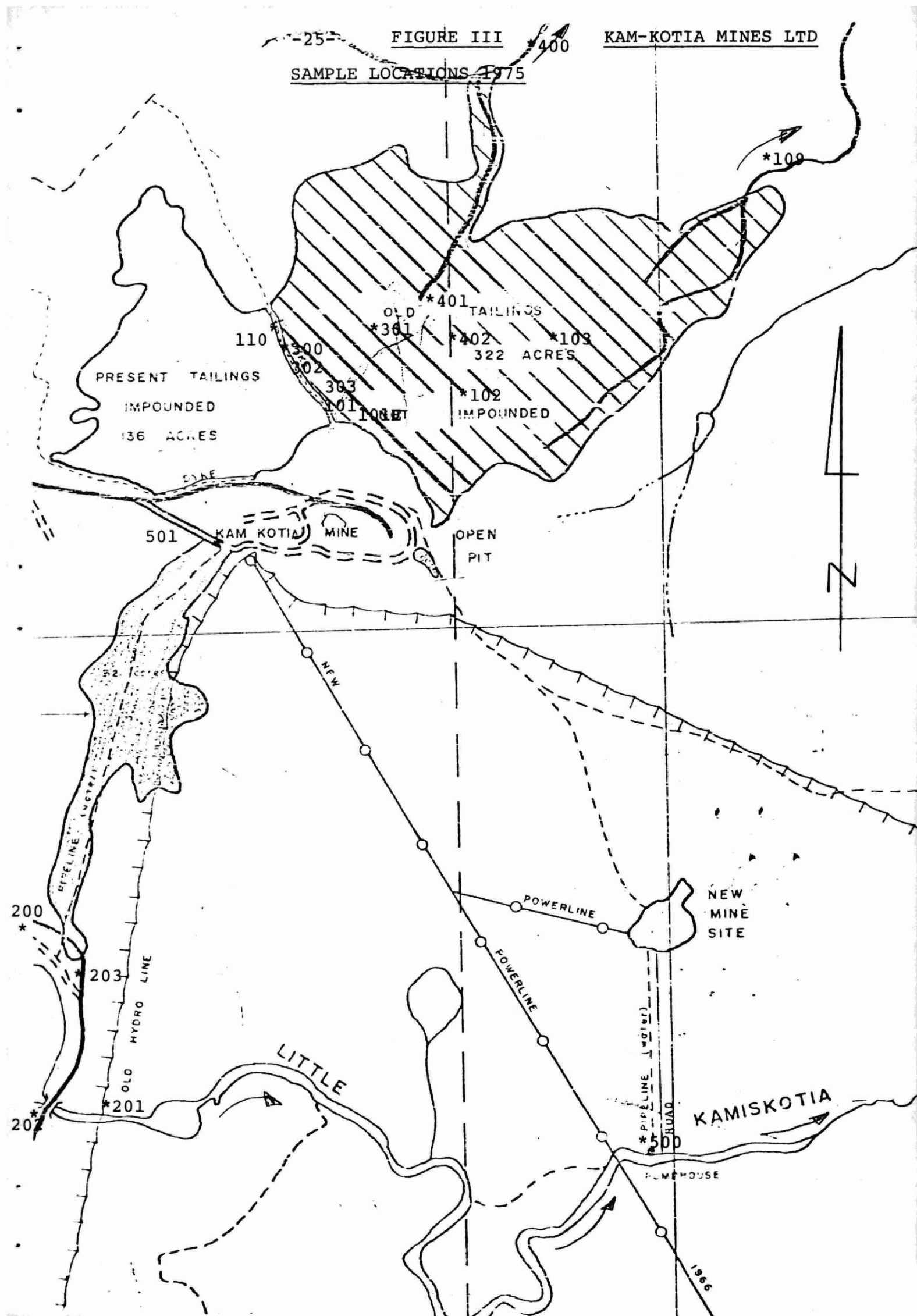


FIGURE III KAM-KOTIA MINES LTD

SAMPLE LOCATIONS 1975



10. QUANTITATIVE RESULTS AND INTERPRETATION OF DATA

Gross contamination of the aqueous environment near the mine-mill complex is quite evident in the results below.

A solid sample (101E) was taken near the toe of north-south dyke, adjacent to a seepage stream. Only the liquid portion was listed below.

Total solids - 30500 ug/ml.
Suspended solids - 3600 ug/ml.
Dissolved solids - 26,900 ug/ml.
Sulphates as (SO_4) - 15,500 ug/ml.
Total Kjeldahl Nitrogen - 95 ug/ml.
Nitrate as (NO_3) - 1.4 ug/ml.
Nitrite as NO_2) - .02 ug/ml.
Total Iron as (Fe) - 8600 ug/ml.
Copper as (Cu) - 3.6 ug/ml.
pH at laboratory - 4.3
Zinc as (Zn) - 340 ug/ml.
Cobalt as (Co) - 10 ug/ml.
Nickel as (Ni) - 0.7 ug/ml.
Chloride as (Cl) - 30 ug/ml.
Manganese as (Mn) - 130 ug/ml.
Lead as (Pb) - 0.25 ug/ml.
Cadmium as (Cd) - 0.25 ug/ml.
Sodium as (Na) - 42 ug/ml.
Potassium as (K) - 1.6 ug/ml.
Calcium as (Ca) - 840 ug/ml.
Arsenic as (As) - 52,600 ug/l. (ppb)
Magnesium as (Mg) - 940 ug/ml.

Acidity as ($CaCO_3$) - 14,700 ug/ml

Alkalinity as ($CaCO_3$) - 0.0 ug/ml.

Hardness as ($CaCO_3$) - 4400 ug/ml.

Free $C\bar{N}$ as (HCN) - 0.01 ug/ml.

Please note (A) All concentrations in this report will be in micrograms per millilitre (ug/ml.) except pH or otherwise noted (1 ug/ml = 1 ppm = 1 mg/l).

(B) Metal analyses represent total concentrations.

10.1 IMPOUNDED TAILING AREA (136 acres)

When the mine was active, the tailings had a high pH level. This was because of the lime that was used in the floatation process as a pyrite depressor and slime conditioner. But since the mine has become dormant, the pH of the decant (recent surface runoff) has been recorded at 2.5 units, and the acidity level was indicated at 2500 ug/ml.

The explanation to this, seems to be a more prominent route towards the oxidation of the sulphuritic materials (large magnitude) than in the oxidation of the thiosalts (producted when sulphur compounds are oxidized - usually above pH 7.0; in an alkaline media).

The impounded tailings mass is in a very active state, and the writer believes that the area in question will continue to deteriorate as long as acid conditions exist (See appendix).

10.2 UNIMPOUNDED TAILINGS AREA (322 ACRES - 1973)

The next area, the unimpounded tailings, is the most important area to discuss. It is well documented (J. Hawley, M.O.E. - 1972) in many papers, that sulphide bearing material can range from 2.5% to 72% in total sulphide content. As Kam-Kotia Mines Ltd. used a fine grind because of differential floatation practices, and that the raw tailings contained sulphides of 45% or higher, it is not hard to believe that with this amount of sulphide material being deposited, the gangue surface area increased, and the right conditions (air and moisture present), the end product produced was an acidic effluent.

The most alarming situation exists at the unimpounded tailings area. Even though the tailings are migrating towards the Kamiskotia River, the moderately high level of pollutants in the seepage flows (from the impounded area) are, in turn, rising at such a rapid rate that undoubtedly, in the very near future, a more noticable impairment of the aquatic environment will come about.

The data for the drainage systems (unimpounded tailings area) is tabulated on page 31.

Comparing the results from the 1971 survey at locations #111 (1971) and #101 (1975), a noticable increase (average 2 fold) is evident for all metallic and non-metallic ions; except iron (Fe) which has increased 29 fold over a four year period.

The seepages #101, #102, #103; #300, #301, #401; and #302, #303, #402 show remarkable increases in contaminants compared to 1971 and also exhibit, what the writer has suspected, that an uptake in concentration of material from the contained tailings area increases with distance travelled over the uncontained tailings area. That is to say, that locations #101, #300 and #302 (sample locations adjacent to north-south dyke) are lower in contaminants compared to the farthest points sampled (#103, #401, and #402).

An increase in material is as follows:

- Arsenic (As); a 110 fold increase from sample #303.
- Zinc (Zn); a 183 fold increase from sample #300.
- Iron (Fe); a 7.2 fold increase from sample #300.
- Cobalt (Co); a 30 fold increase from sample #300.

Total dissolved solids and the sulphate ion in all seepages are rapidly rising and the pH levels are decreasing from 1971, on the average of ½ units.

The accumulation of metals that are not associated drastically with the ore body are, as above found in the effluents from mining properties. As chalcopyrite (CuFeS) breaks down, trace metals are released and often interchange with the iron in the FeS lattice. This can explain the presence of metals that are not normally associated with the ore in question.

10.3 WASTE WATER DISCHARGE AREA (82 ACRES) (EARLY DISCHARGE AREA)

Although Kam-Kotia Mines Limited is not discharging minewater there is an impairment of the drainage system below the northern part of the discharge area. The results from sample #501 indicate the following:

A 13 fold increase in Zinc (Zn) over four years - sample #106 (1971); and a 2.4 fold increase in iron (Fe) over four years - sample #106 (1971).

Leaching of metals is presently taking place in the waste water discharge area, according to the results of sample #203. (Ditch beside Hwy #576 leading to river).

An increase in material is as follows:

- A 3.8 fold increase in total solids over four years - sample #116 (1971).
- A 3.5 fold increase in the sulphate ion over four years - sample #116 (1971).
- A 438 fold increase in the total iron (Fe) content over four years - Sample #116 (1971).
- A 47.4 fold increase in the copper (Cu) content over four years - sample #116 (1971).
- A 30.8 fold increase in the zinc (Zn) content over four years - sample #116 (1971).

The analytical data for the drainage system (waste water discharge area) -(Early tailings discharge) is tabulated on page 32.

TABLE VII

11. DRAINAGE SYSTEMS - KAMISKOTIA RIVER

Location No.	SOLIDS			pH (Lab)	SO_4	Zn	Fe	Cu	Ni	As	Co
	Total	Susp	Diss								
#101 (seepage)	11690	90	11600	2.6	6800	360	1500	110	0.30	1.6	3.9
#102 (Seepage)	11980	80	11900	2.5	7000	350	1600	94	0.34	1.8	4.1
#103 (Seepage)	12530	130	12400	2.5	7400	350	1600	89	0.33	3.6	4.2
#300 (Seepage)	2980	250	2730	3.2	1650	1.2	390	0.40	<.02	0.11	0.15
#301 (Seepage)	12870	9120	3750	2.6	2400	6.6	730	1.2	0.19	0.22	0.40
#401 (Seepage)	20100	100	2000	2.4	11700	220	2800	17	0.36	2.9	4.5
#302 (Seepage)	12500	100	12400	2.8	7500	62	2100	21	0.19	0.8	3.8
#303 (Seepage)	5480	80	5400	2.7	3200	18	360	0.92	0.06	0.1	0.48
#402 (Seepage)	13760	160	13600	2.5	8000	140	2990	12	0.35	11.0	3.6

TABLE VIII

12. DRAINAGE SYSTEMS - LITTLE KAMISKOTIA RIVER

Location No.	Solids			pH (Lab)	SO_4	Zn	Fe	Cu	Ni	As	Co
	Total	Susp.	Diss.								
#501 Seepage Mine water Area)	2200	20	2180	2.9	1460	120	130	13	0.11	.053	0.75
#203 Ditch -HWY 576 - to River)	6380	340	6040	2.5	3680	120	700	18	0.20	.0098	3.6

TABLE IX

13. WATER QUALITY - LITTLE KAMISKOTIA RIVER AND KAMISKOTIA LAKE

Location No.	Solids			pH (Lab)	SO_4	Zn	Fe	Cn	Ni	As	Co
	Total	Susp.	Diss.								
#200 (Kamis-kotia Lake-Wharf)	150	60	90	7.8	9	0.05	1.9	0.2	0.02	0.0034	<0.02
#202 Kamis-kotia Lake-North of River)	-	15	105	7.6	17	0.12	0.51	<0.01	<.02	0.0014	<.02
#201 (Mouth of Little Kamis-kotia River)	-	<15	150	7.0	67	1.3	0.61	.07	.02	.0014	.04

TABLE X

14. QUANTITATIVE ANALYTICAL DATA - KAM-KOTIA MINE LIMITED

DRAINAGE SYSTEMS - SEEPAGES - 1971, 1975

Location No.	SOLIDS			pH							
	Total	Susp	Diss.	(Lab)	SO_4	Zn	Fe	Cu	Ni	As	Co
#111 (1971)	8000	40	7960	2.7	4530	160	51	57	0.15	0.03	1.96
#110 (1975)	11690	90	11600	2.6	6800	360	1500	110	0.30	1.59	3.9
#110 (1971)	7700	110	7590	2.6	4570	150	48	53.7	0.18	0.03	2.00
#303 (1975)	5480	80	5400	2.7	3200	18	360	0.92	0.06	0.12	0.48
#109 (1971)	1560	100	1460	4.3	910	0.10	76	0.11	0.05	0.00	0.03
#302 (1975)	12500	100	12400	2.8	7500	62	2100	21	0.19	0.78	3.8
#108 (1971)	850	10	840	3.4	529	0.29	15	0.07	0.10	0.000	0.05
#300 (1975)	2980	250	2730	3.2	1650	1.2	390	0.40	<0.02	0.11	0.15
#101 (1971)	1270	15	1255	2.9	800	0.04	6.0	0.0	0.00	0.02	0.03
#102 (1971)	1330	10	1320	2.8	806	0.10	6.1	0.0	0.00	0.02	0.00
#110 (1975)	5230	100	5130	2.5	2700	49	560	3.2	0.12	1.2	0.93
#106 (1971)	2830	30	2810	2.7	1620	9.0	124	2.28	0.08	0.01	0.30
#501 (1975)	2200	20	2180	2.9	1460	120	130	13	0.11	.053	0.75
#116 (1971)	1690	5	1685	3.1	1030	3.9	1.6	0.38	0.07	0.00	0.30
#128 (1971)	1100	50	1050	2.9	572	9.5	36	1.1	-	-	-
#203 (1975	6380	340	6040	2.5	3680	120	700	18	0.20	0.01	3.6
#115 (1971	1380	15	1365	2.9	864	1.21	20	0.26	0.12	<.01	0.10
#400 (1975	7600	50	7550	2.5	3450	65	560	9.2	0.16	0.74	1.7

NOTES Samples #102, and #103 are a continuation of seepage stream sample #101.

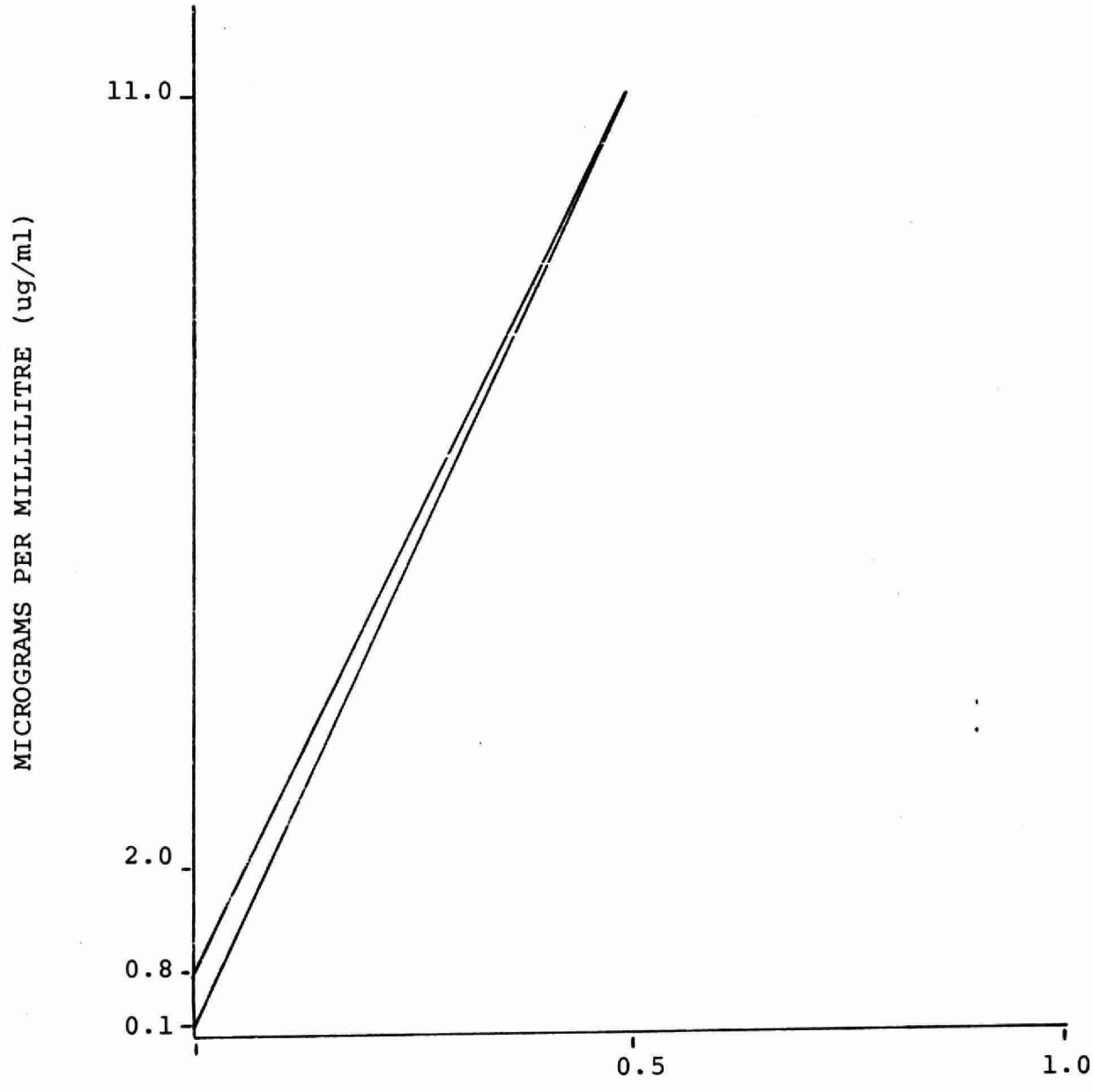
Samples #301 and #401 are a continuation of seepage stream sample #300.

Sample #402 is a continuation of seepage stream samples #302, and #303.

FIGURE IV

MICROGRAMS PER MILLILITRE OF ARSENIC (As)

VERSUS MIGRATION FROM NORTH-SOUTH DYKE

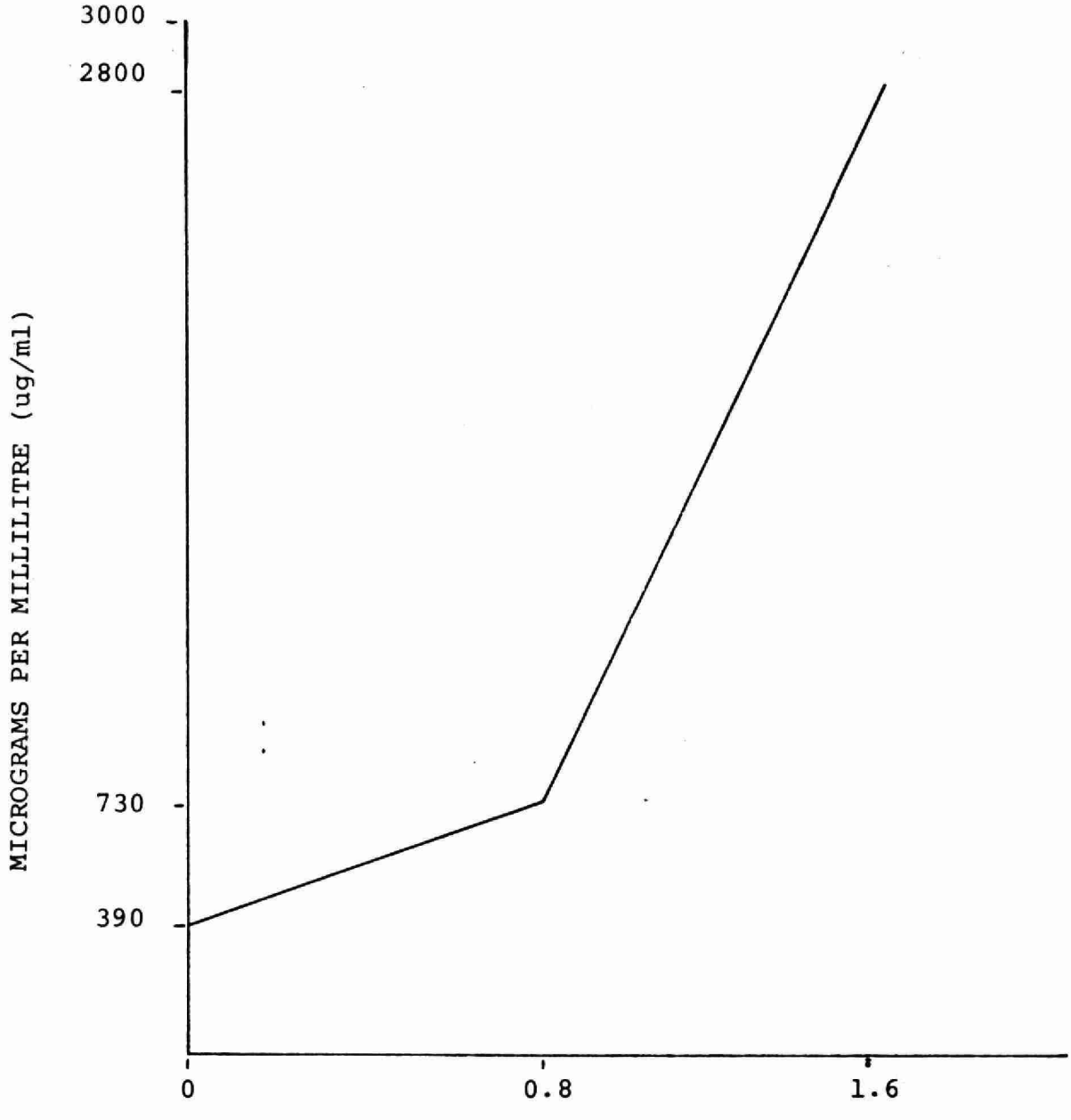


SAMPLES #302, #303, and #402

FIGURE V

MICROGRAMS PER MILLILITRE OF IRON (Fe)

VERSUS MIGRATION FROM NORTH-SOUTH DYKE

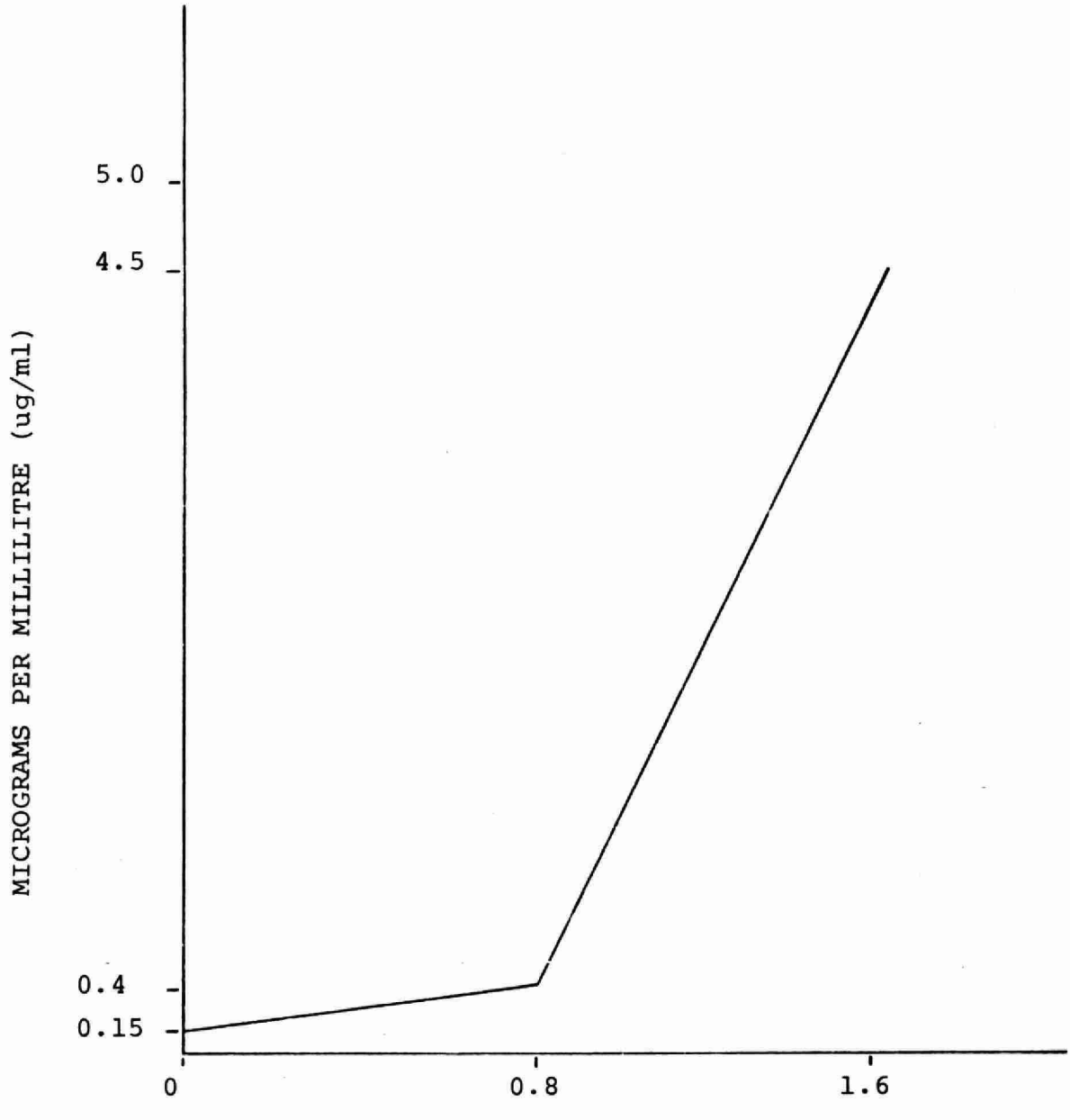


SAMPLES #300, #301, and #401

FIGURE VI

MICROGRAMS PER MILLILITRE OF COBALT (Co)

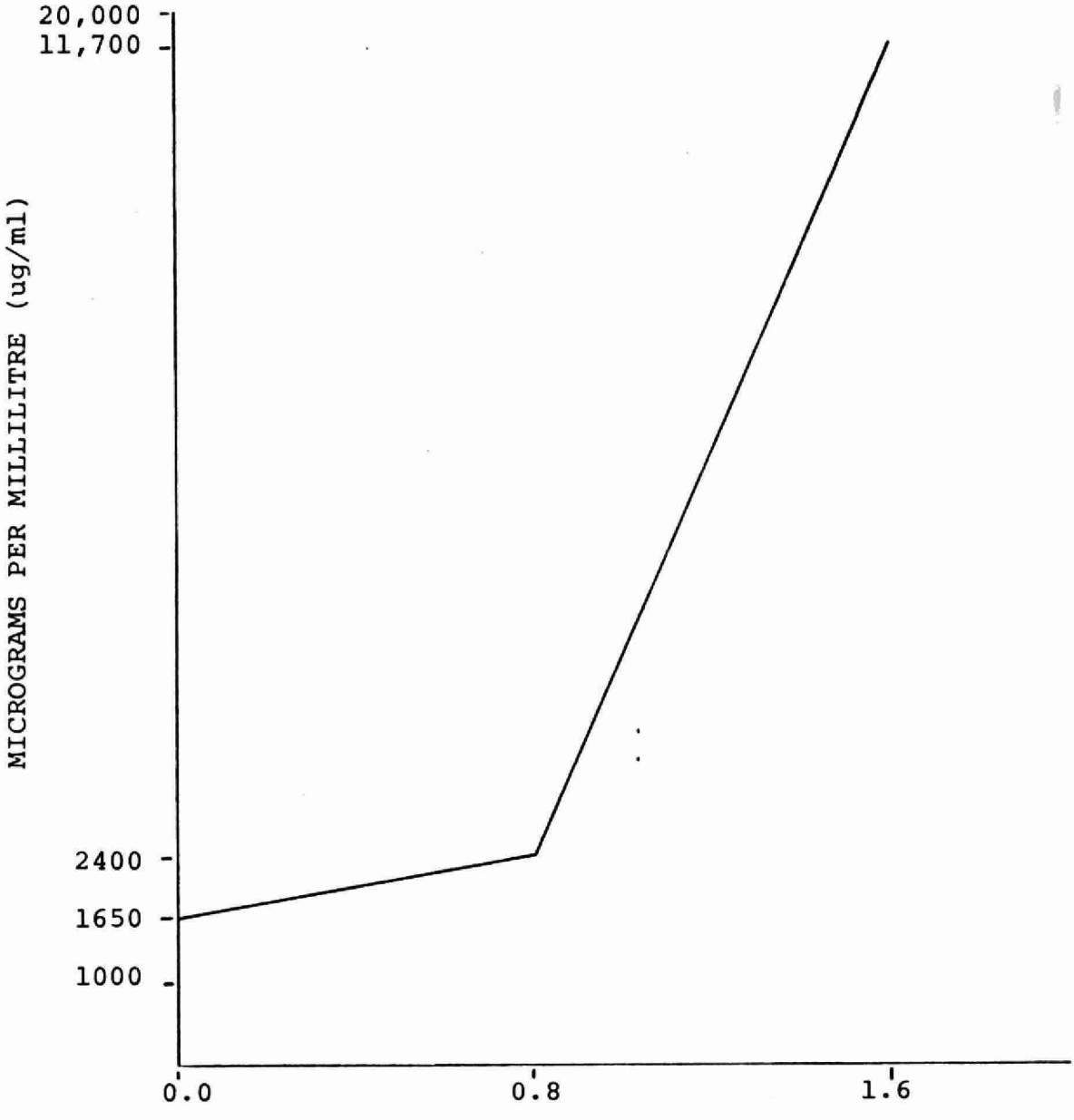
VERSUS MIGRATION FROM NORTH-SOUTH DYKE



SAMPLES #300, #301, and #401

FIGURE VII

MICROGRAMS PER MILLILITRE OF SULPHATE (SO_4) VERSUS MIGRATION FROM NORTH-SOUTH DYKE

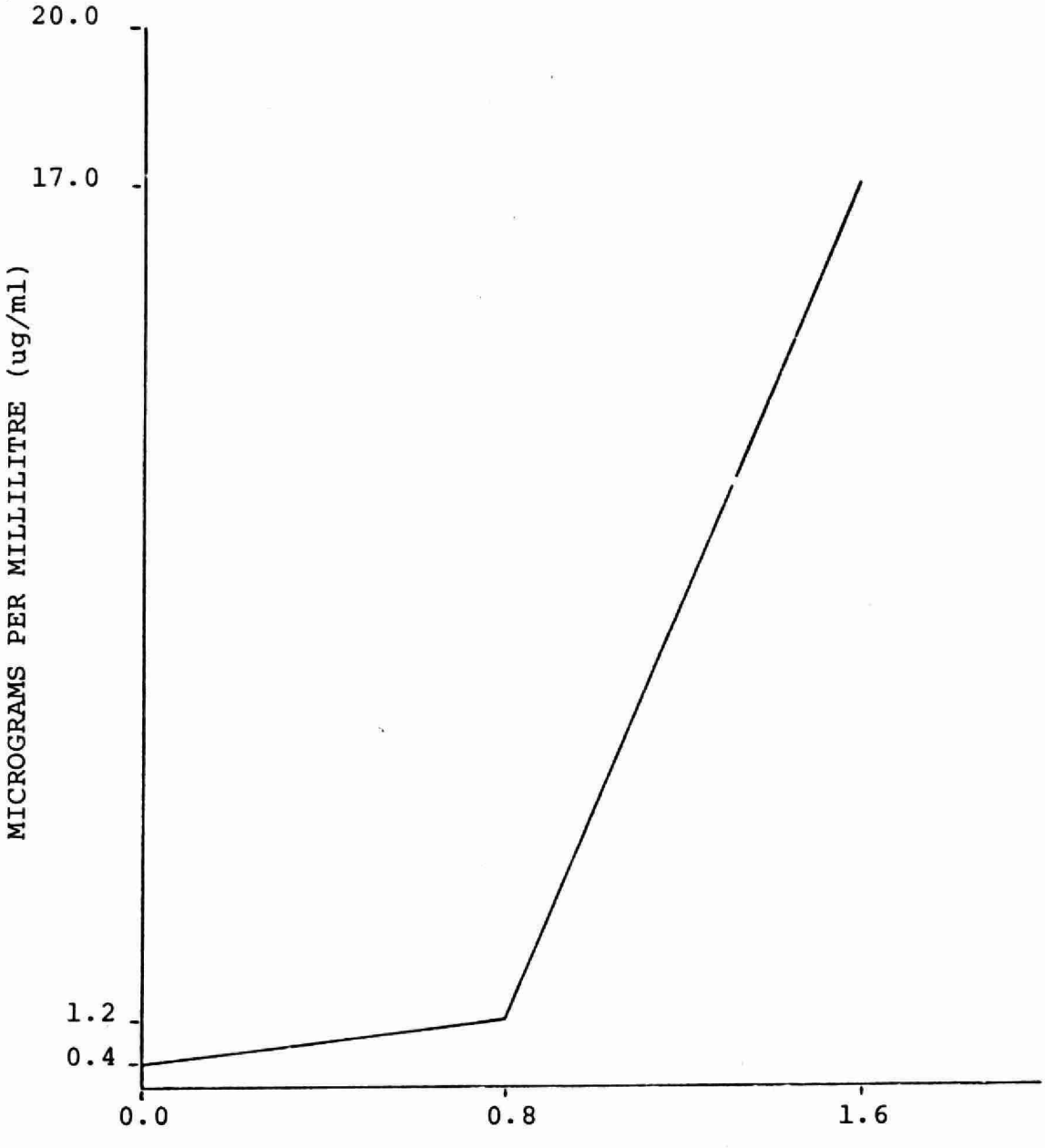


SAMPLES #300, #301, and #401

FIGURE VIII

MICROGRAMS PER MILLILITRE OF COPPER (Cu)

VERSUS MIGRATION FROM NORTH-SOUTH DYKE

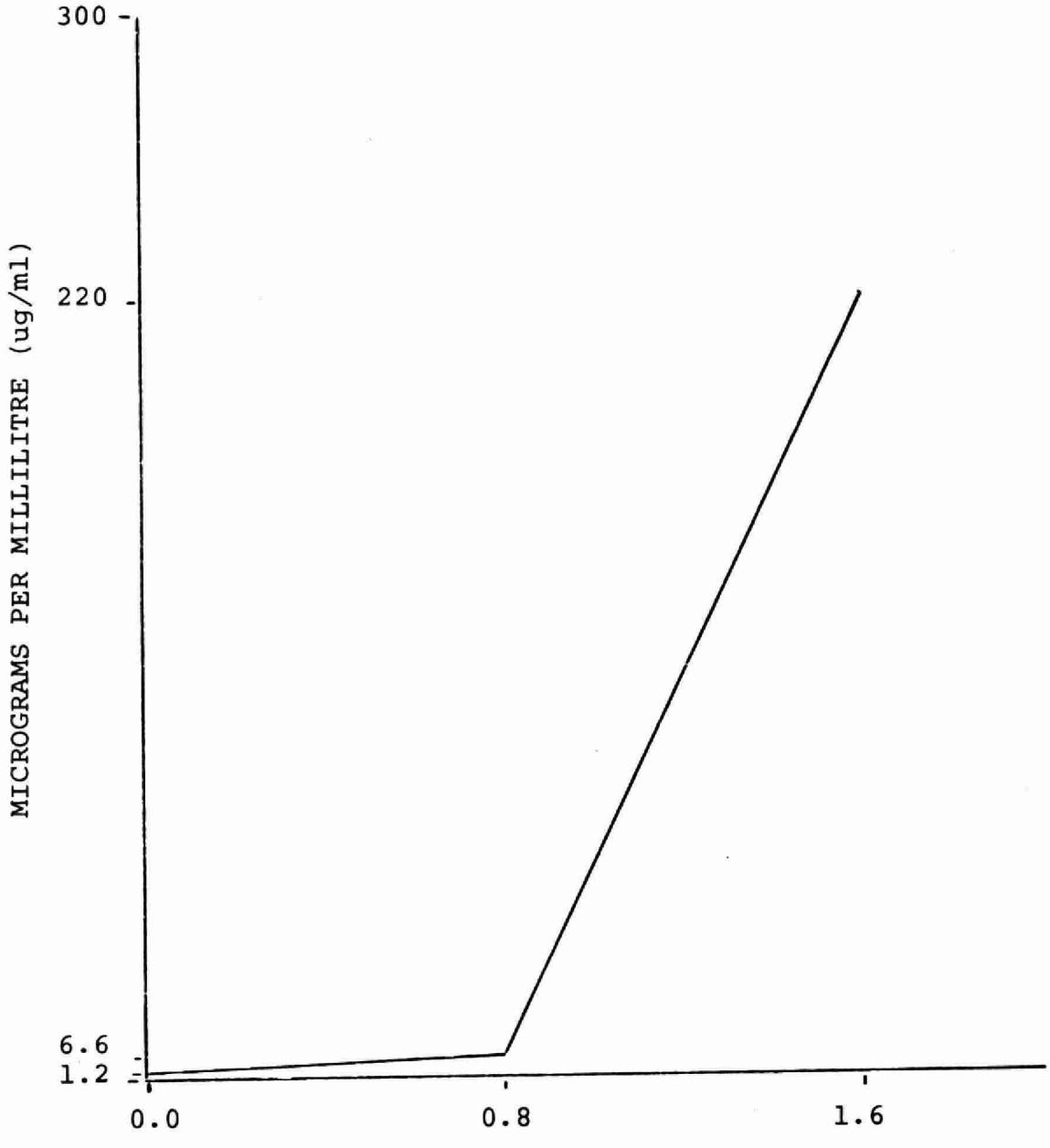


SAMPLES #300, #301, and #401

FIGURE IX

MICROGRAMS PER MILLILITRE OF ZINC (Zn)

VERSUS MIGRATION FROM NORTH-SOUTH DYKE

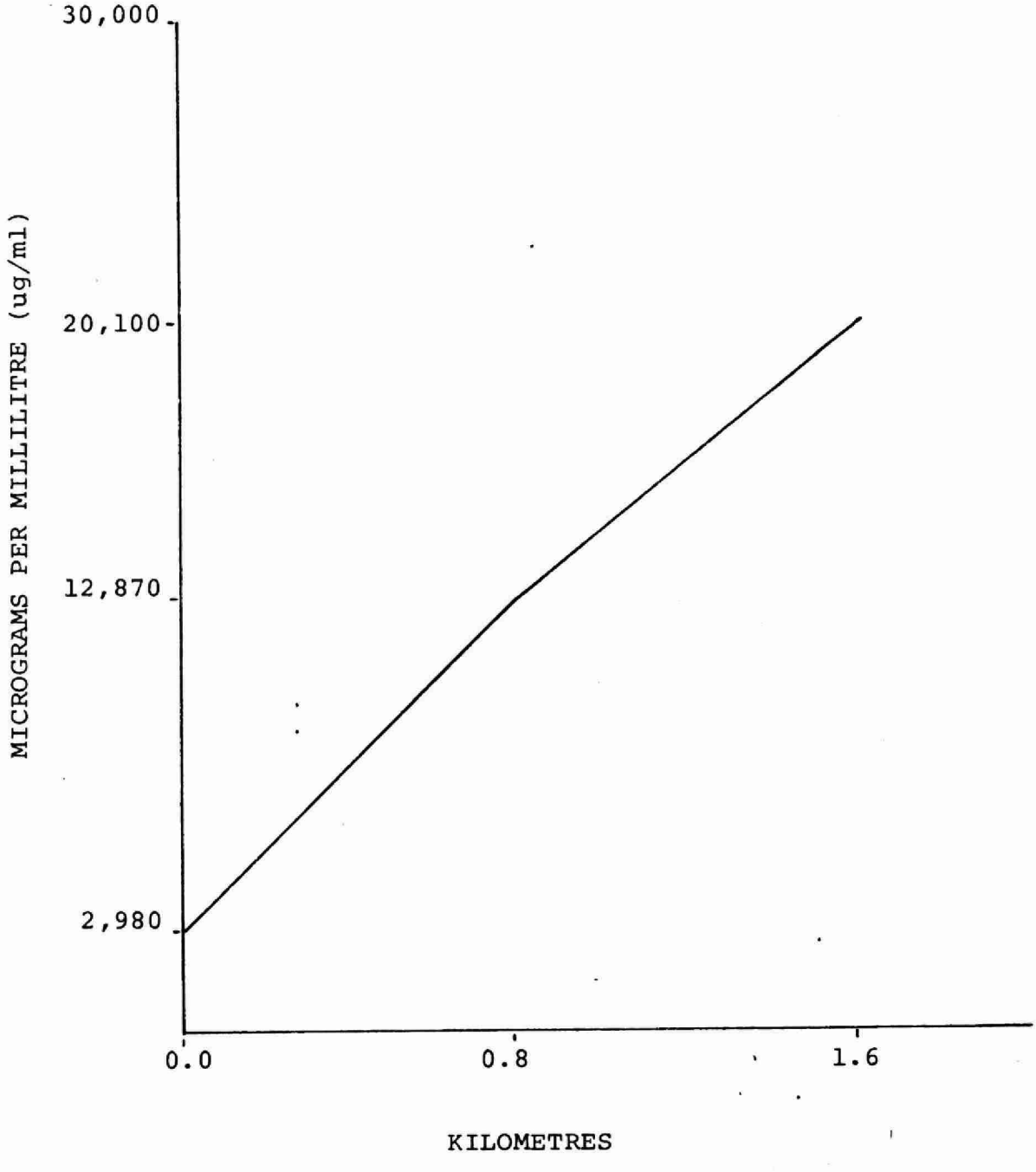


SAMPLES #300, #301, and #401

FIGURE X

MICROGRAMS PER MILLILITRE OF TOTAL SOLIDS (TS)

VERSUS MIGRATION FROM NORTH-SOUTH DYKE

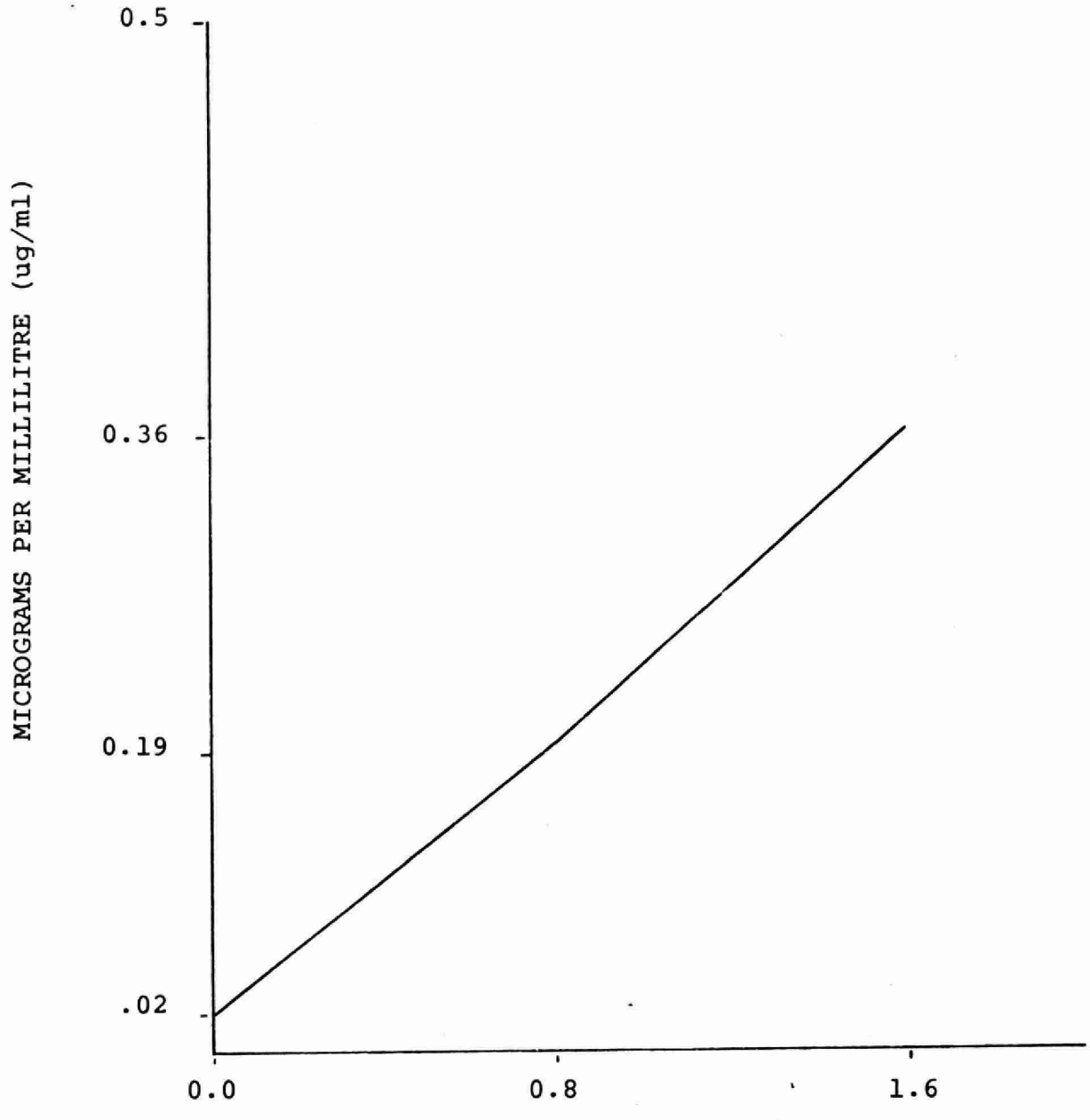


SAMPLES #300, #301, and #401

FIGURE XI

MICROGRAMS PER MILLILITRE OF NICKEL (Ni)

VERSUS MIGRATION FROM NORTH-SOUTH DYKE



SAMPLES #300, #301, and #401

15. KAM-KOTIA MINES LIMITED - ANALYTICAL DATA - 1975

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

(-)

All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited
Source: Kamkotia decant and liquid portion of a solid sample location is same as sample 101

Report to: C.R. Gibson.
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin blvd., W., Timmins, Ontario

c.c.

Date Sampled: Sept 15/75 by: Wayne Finch
Date Analysed: Oct 10.75

br

Lab. No.	pH - at Lab.	Turbidity FTU	SOLIDS Tot.	SOLIDS Susp.	SOLIDS Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N Free Ammonia	NITROGEN AS N Total Kjeldahl	NITROGEN AS N Nitrite	NITROGEN AS N Nitrate	True Colour
(1)	2.5	-------	5230	100	5130	0.00	2500	2700	-----	6.0	0.16	0.2	------
(2)	4.3	-------	30500	3600	26900	-------	14700	15500	-----	9.5	0.02	1.4	------

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pb	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	1.6	320	3	<2	0.01	0.93	19	61	560	0.05	1.2	3.2	49
(2)	16	840	42	30	0.25	10	130	940	8600	0.25	526	3.6	340

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molyderum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm @ 25°C	Free CN as HCN
(1)	-----	-------	--------	1200	-------	0.12	--------	--------	-----	-----	-----	------	----- <0.01
(2)	-----	-------	--------	4400	-------	0.70	-------	--------	-----	-----	-----	------	----- <0.01

(1) 110 T37-58

(2) 101E T37-59

MINISTRY OF THE ENVIRONMENT
CHEMICAL LABORATORIES
INDUSTRIAL WASTES

All analyses (except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited
Source: Effluent from impounded tailings

Date Sampled: Sept 15/75 by: Wayne Finch
Date Analysed: Oct 10/75

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin Blvd., W., Timmins, Ontario

c.c.

br

Lab. No.	pH - at Lab.	Turbidity FTU	S O L I D S Tot.	S O L I D S Susp.	S O L I D S Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N Free Ammonia	NITROGEN AS N Total Kjeldahl	NITROGEN AS N Nitrite	NITROGEN AS N Nitrate	True Colour
(1)	2.6	------	11690	90	11600	0.00	5500	6800	------	2.0	.20	<.2	------
(2)	2.5	------	11980	80	11800	0.00	5500	7000	------	1.5	.32	<.2	------

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pb	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	4.5	430	37	<2	0.59	3.9	47	370	1500	<0.1	1.5	110	360
(2)	2.6	400	36	<2	0.56	4.1	50	410	1600	<0.1	1.8	94	350

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm @ 25°C	Free CN as HCN
(1)	-----	-------	--------	3500	------	.30	--------	--------	------	------	-----	-------	------
(2)	-----	-------	--------	3300	------	.34	--------	--------	------	------	-----	-------	------

40:81

(1) 101 T37-54

(2) 102 T37-55

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited
Source: Effluent from impounded area

Date Sampled: Sept 15/75 by: Wayne Finch
Date Analysed: Oct 10/75

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin Blvd., W., Timmins, Ontario

c.c.

br

Lab. No.	pH at Lab.	Turbidity FTU	S O Tot.	L I Susp.	D S Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N: Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	True Colour
(1)	2.5	-------	12530	130	12400	0.00	5500	7400	------	2.0	.34	<.2	------
(2)	2.5	-------	11180	80	11100	0.00	5500	6100	------	8.0	.44	<.2	------

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pb	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	2.1	340	34	<2	0.58	4.2	49	430	1600	<0.1	3.6	89	350
(2)	1.3	290	4	<2	0.24	4.1	27	200	1500	.03	3.3	16	110

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm @ 25°C	Free CN as HCN
(1)	--------	-------	-------	3500	--------	.33	-------	--------	------	-----	------	-----	------ <0.01
				1900		32							<0.01

(1) 103 T37-56

(2) 104 T37-57

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited

Source: Kamkotia Lake at Main wharf and mouth of the Little Kamkotia River (Field pH 7.2)

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment

c.c.

Date Sampled: Sept 15/75 by: Wayne Finch
Date Analysed: Oct 10.75

Lab. No.	pH - at Lab.	Turbidity FTU	S O L I D S Tot.	S O L I D S Susp.	S O L I D S Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N Free Ammonia	NITROGEN AS N Total Kjeldahl	NITROGEN AS N Nitrite	NITROGEN AS N Nitrate	True Colour
(1)	7.8	-------	150	60	90	46	2.2	9	0.1	0.6	<.02	<.2	
(2)	7.0	-------	------	<15	150	36	7.1	67	0.4	0.4	<.02	<.2	

	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pb	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	0.5	16	2	3	<0.01	<0.02	0.06	4.1	1.9	<0.1	0.0034	0.2	0.05
(2)	0.6	28	4	7	<0.01	0.04	.48	6.3	0.61	<.01	0.0014	0.07	1.3

	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm @25C	Free CN as HCN
(1)	-----	.08	-----	55	------	.02	-------	--------	-----	-----	-------	-----	------ <0.01
(2)	-----	.04	-----	100	-------	.02	--------	--------	-----	-----	-------	-----	------ <0.01

(1) 200 T37-68

(2) 201 T37-69

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited
Source: Kamkotia Lake at River mouth and ditch beside Hwy 576 leading to river

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin Blvd., W., Timmins, Ontario

c.c.

Date Sampled: Sept 15/75 by: Wayne Finch
Date Analysed: Oct. 16/75

Lab. No.	pH at Lab.	Turbidity FTU	SOLIDS Tot.	SOLIDS Susp.	SOLIDS Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N: Free Ammonia	NITROGEN AS N: Total Kjeldahl	NITROGEN AS N: Nitrite	NITROGEN AS N: Nitrate	True Colour
(1)	7.6	-----	------	15	105	40	2.2	17	0.2	0.4	<.02	<.2	------
(2)	2.5	------	6380	340	6040	0	3080	3680	12.0	14.0	.18	<.2	------

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pb	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	0.5	16	2	3	<0.01	<.02	0.06	3.7	0.51	<0.1	0.0014	<0.01	0.12
(2)	1.7	360	78	52	0.24	3.6	20	150	700	<.02	0.0098	18	120

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm	Free CN as HCN
(1)	-------	.08	-------	58	------	<.02	--------	---------	-----	------	------	------	<0.01
(2)	-------	0.6	-------	1800	------	.20	--------	---------	-----	------	------	------	<.01

(1) 202 T37-70

(2) 203 T37-71

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin Blvd., W., Timmins, Ontario

c.c.

Source: Seepage from impoundment area (3/4 mi. north of sample 101) and seepage along unimpounded area approx ½ mi from sample 300

Date Sampled: Sept 15/75 Date analysed 10/10/75 by: Wayne Finch

Lab. No.	pH - at Lab.	Turbidity FTU	SOLIDS Tot.	SOLIDS Susp.	SOLIDS Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N: Free Ammonia	NITROGEN AS N: Total Kjeldahl	NITROGEN AS N: Nitrite	NITROGEN AS N: Nitrate	True Colour
(1)	3.2	-----	2980	250	2730	0.00	770	1650	2.4	4.3.	<.2	0.08	----
(2)	2.6	----	12870	9120	3750	0.00	2100	2400	3.6	20	<.2	0.04	----

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pb	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	6.6	350	23	<2	0.01	0.15	6.3	81	390	.01	0.11	0.40	1.2
(2)	7.6	370	-----	-----	0.03	0.40	8.4	110	730	0.13	0.22	1.2	6.6

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm cubed	Free CN as HCN
(1)	-----	-----	------	1260	-----	<.02	------	-------	-----	----	-----	-----	<0.01
(2)	-----	-----	------	1560	-----	0.19	-------	-------	-----	----	-----	------	<0.01

(1) 300 T38-15

(2) 301 T38-16

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited

Source: Seepage from impounded area ¼ miles S.E. from sample 300 and seepage from impounded area ¼ mile S.E. from sample 302

Date Sampled: Sept 12/75 Date analysed 10/10/75 By: Wayne Finch

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin Blvd., W., Timmins, Ontario

c.c.

Lab. No.	pH - at Lab.	Turbidity FTU	S O L I D S Tot.	S O L I D S Susp.	S O L I D S Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N Free Ammonia	NITROGEN AS N Total Kjeldahl	NITROGEN AS N Nitrite	NITROGEN AS N Nitrate	True Colour
(1)	2.8	------	12500	100	12400	0.00	5800	7500	----	5.0	<.2	0.12	------
(2)	2.7	-----	5480	80	5400	0.00	1550	3200	2.8	3.6	<.2	0.02	

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pb	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	8.0	400	40	<2	0.15	3.8	0.22	260	2100	0.13	0.78	21	62
(2)	6.9	480	41	-----	0.03	0.48	12	190	360	<.01	0.120	0.92	18

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm @ 25°C	Free CN as HCN
(1)	----	<.02	-----	2600	------	0.19	-----	------	-----	-----	-----	-----	<0.01
(2)	----	<.02	-----	2180	------	0.06	-----	------	-----	-----	-----	-----	<0.01

(1) 302 T38-17

(2) 303 T38-18

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin Blvd., W., Timmins, Ontario

c.c.

Source: North Kamkotia Creek before joining South Kamkotia Creek and start of effluent flow in unimpounded tailing before joining North Kamkotia Creek.

Date Sampled: Sept 15/75 Date Analysed: Oct 16.75 by: Wayne Finch

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Lab. No.	pH - at Lab.	Turbidity FTU	SOLIDS Tot.	SOLIDS Susp.	SOLIDS Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N: Free Ammonia	NITROGEN AS N: Total Kjeldahl	NITROGEN AS N: Nitrite	NITROGEN AS N: Nitrate	True Colour
(1)	2.5	-----	7600	50	7550	0.00	2330	3450	3.8	5.8	<.2	0.12	-----
(2)	2.4	-----	20100	100	20000	0.00	12000	11700	----	9.5	-----	-----	-----

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pt	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	2.7	380	8	<2	0.15	1.7	22	99	560	0.06	0.74	9.2	65
(2)	0.6	320	20	<2	0.36	4.5	36	320	2800	0.01	2.9	17	220

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm squared	
(1)	-----	0.06	-----	1560	------	0.16	------	------	-----	------	-----	-----	------ Free CN as HCN <0.01
(2)	-----	0.50	-----	2850	------	0.36	------	------	-----	------	-----	-----	------ <0.01

(1) 400 T38-12

(2) 401 T38-13

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin Blvd., W., Timmins, Ontario

c.c.

Source: Effluent draining on unimpounded tailings from 303 approx ½ mile to distance

Date Sampled: Sept 18/75 by: Wayne Finch
Date Analysed: Oct 18/75

Lab. No.	pH - at Lab.	Turbidity FTU	SOLIDS Tot.	SOLIDS Susp.	SOLIDS Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N: Free Ammonia	NITROGEN AS N: Total Kjeldahl	NITROGEN AS N: Nitrite	NITROGEN AS N: Nitrate	True Colour
(1)	2.5	------	13760	160	13600	0.01	7000	8000	4.0	5.5	-----	-----	------

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pb	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	3.7	260	40	<2	0.23	3.6	37	310	2990	<0.1	11.0	15	140

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm squared	
(1)	-----	0.60	------	2500	-------	0.35	-------	-------	-----	-----	-------	----	------

Free CN as HCN <0.01

(1) 402 T38-14

MINISTRY OF THE ENVIRONMENT

CHEMICAL LABORATORIES

INDUSTRIAL WASTES

*All analyses except pH reported in mg/litre unless otherwise indicated

Municipality: Township of Robb
Kamkotia Mines Limited

Source: Marsh Lake - Jameland Mines Ltd. and drainage from mine water discharge area Kamkotia Mines Limited

Date Sampled: Sept 19/75 by: Wayne Finch
Date Analysed: October 10, 1975

Report to: C.R. Gibson
Industrial Officer
Industrial Abatement
Ministry of the Environment
83 Algonquin Blvd., W., Timmins, Ontario

c.c.

br

Lab. No.	pH - at Lab.	Turbidity FTU	SOLIDS Tot.	SOLIDS Susp.	SOLIDS Diss.	Alkalinity as $CaCO_3$	Acidity as $CaCO_3$	Sulphate as SO_4	NITROGEN AS N: Free Ammonia	NITROGEN AS N: Total Kjeldahl	NITROGEN AS N: Nitrite	NITROGEN AS N: Nitrate	True Colour
(1)	7.1	------	------	15	170	41	3.5	53	0.8	0.8	<.2	<.02	------
(2)	2.9	------	2200	20	2180	0.00	1100	1460	.6	1.0	<.2	.02	------

Lab. No.	Potassium as K	Calcium as Ca	Sodium as Na	Chloride as Cl -	Cadmium as Cd	Cobalt as Co	Manganese as Mn	Magnesium as Mg	Iron as Fe	Lead as Pt	Arsenic as As	Copper as Cu	Zinc as Zn
(1)	0.6	34	3	5	0.01	0.02	0.19	5.7	1.9	<.01	<.001	0.02	1.5
(2)	1.4	190	7	< 2	0.23	0.75	5.9	44	130	<.01	.053	13	170

Lab. No.	Chromium as Cr	Phosphorus as P	Mercury as Hg	Hardness as $CaCO_3$	Titanium as Ti	Nickel as Ni	Silver as Ag	Barium as Ba	Molybdenum as Mo	Lithium as Li	Aluminum as Al	Conductivity in micromhos per cm @ 25°C	
(1)	-----	.04	----	104	-------	<0.02	--------	--------	------	------	------	------	------- Free CN as HCN <0.01
(2)	-----	.04	----	790	-------	0.11	--------	--------	-----	------	-----	------	------ <0.01

(1) 500 T38-32

(2) 501 T-38-67

16. KAM-KOTIA MINES LIMITED - ANALYTICAL DATA - 1971

CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

All analyses except pH reported in p.p.m. unless otherwise indicated

1 p.p.m. = 1 mgm. / litre = 1 lb./100,000 Imp. Gals.

Municipality: Twp. of Robb Report to: L.E. Olivier c.c.

Source: Kam Kotia Mines Limited

Date Sampled: July/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphates as SO_4	NITROGEN AS N			Total Phos. as P	Total Iron as Fe*	Copper as Cu*	pH at Lab.
		Total	Susp.	Diss.		Free Ammonia	Total Kjeldahl	Nitrate	Nitrite			
T28-207		1270	15	1255	800	0.1	1.3	<.1	<.01	.18	6.0	0.0	2.9
T28-208		1330	10	1320	806	<.1	1.4	<.1	<.01	.10	6.1	0.0	2.8

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.	Manganese as Mn.*	Lead as Pb.*	Vanadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-207	0.04	0.03	0.00	0.63	10	0.39	0.0	0.0	0.00	**	0.0	0.0
T28-208	0.10	0.00	0.00	0.85	11	0.48	0.0	0.0	0.00	<1	0.0	0.0

** Exhausted

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as As.*	Magnesium as Mg.*	Acidity As $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-207	**	Unpreserved sample exhausted	0.0	20	10	280	0.02	3.95	109	0	710
T28-208	**	<1	0.0	20	11	288	0.02	4.4	94	0	750

T28-207	101
T28-208	102

CHEMICAL LABORATORIES

All analyses except pH reported in p.p.m. unless otherwise indicated

INDUSTRIAL WASTE ANALYSIS

1 p.p.m. = 1 mgm. / litre
= 1 lb./100,000 Imp. Gals.

Municipality: Twp. of Robb

Report to: L.E. Olivier,
127 Cedar St.,
Sudbury, Ont.

c.c.

Source: Kam Kotia Mines Limited

Date Sampled: July 1/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphate as SO_4	NITROGEN		AS	N	Total Phos. as P.	Total Iron as Fe.*	Copper as Cu.*	pH at Lab
		Total	Susp.	Diss.		Free Ammonia	Total Kjeldahl	Nitrate	Nitrite				
T28-226		1400	750	650	583	8.0	13.	9.0	.36	.48		3.16	7.5
T28-204		3070	2190	880	125	9.4	14.	16.	1.2	1.7	158.	11.2	8.6
T28-224		630	240	390	59	4.0	4.8	8.6	1.0	.20	35.	1.55	7.3

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.*	Manganese as Mn.*	Lead as Pb.*	Vanadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-226	17.	0.20	0.02	46.	28	2.96	0.0	1.4	0.00	<1	0.0	5.2
T28-204	8.70	0.14	0.10	60.	54	2.43	0.0	1.6	0.01	**	0.0	8.0
T28-224	1.44	0.10	0.04	17.5	36	0.83	0.0	0.2	0.00	<1	0.0	0.64

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as As.*	Magnesium as Mg.*	Acidity as $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-226	*	<1	0.0	24	3.9	172	0.26	60.5	19	158	720
T28-204	0.0	**	0.03	**	**	130	0.03	112	6	232	*210
T28-224	*	<1	0.0	32	5.6	63	0.10	35.	18	158	204

T28-226 103 - July 14, 1971

T28-204 104 - July 13, 1971

T28-224 105 - Jameland Minewater Discharge - July 14, 1971

CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

All analyses except pH reported in p.p.m. unless otherwise indicated

1 p.p.m. = 1 mgm / litre
= 1 lb./100,000 Imp. Gals.

Municipality: Twp. of Robb

Report to: L.E. Olivier,
127 Cedar St.,
Sudbury, Ont.

c.c.

Source: Kam Kotia Mines Limited

Date Sampled: July 1/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphate as SO_4	NITROGEN		AS	N	Total Phos. as P.	Total Iron as Fe.*	Copper as Cu.*	pH at Lab
		Total	Susp.	Diss.		Free Ammonia	Total Kjeldahl	Nitrate	Nitrite				
T28-223		2830	30	2810	1620	5.8	6.5	<.1	.05	.040	124.	2.28	2.7
T28-221		390	10	380	63	1.6	1.3	6.9	.98	.040	0.2	0.02	8.1
T28-215		850	10	840	529	0.2	.90	<.1	.01	.02	75.	0.07	3.4

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.*	Manganese as Mn.*	Lead as Pb.*	Vanadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-223	9.0	0.30	0.08	12.7	8	3.81	0.0	0.60	0.00	< 1	0.0	0.2
T28-221	0.01	0.09	0.10	0.12	22	0.11	0.0	0.0	0.0	< 1	0.0	0.0
T28-215	0.29	0.05	0.10	14.60	10	3.89	0.0	0.0	0.00	< 1	0.0	0.02

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as A.*	Magnesium as Mg.*	Acidity as $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-223	*	Not Ammenable to analysis	0.0	30	2.8	350.	0.01	61.	644	0	0
T28-221	*	<1	0.0	29	5.5	51.0	0.00	16.0	8	128	184
T28-215	**	<1	0.0	22	2.1	162	0.00	10.4	125	0	400

T28-223 106 - July 14, 1971
T28-221 107 - July 14, 1971
T28-215 108 - July 13, 1971

* Interference due to high content

** No method at present

CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

All analyses except pH reported in p.p.m. unless otherwise indicated

1 p.p.m. = 1 mgm. / litr
= 1 lb./100,000 Imp. Ga

Municipality: Twp. of Robb

Report to: L.E. Olivier, 127 Cedar St., Sudbury, Ont.

c.c.

Source: Kam Kotia Mines Limited

Date Sampled: July 1/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphate as SO_4	NITROGEN		AS	N	Total Phos. as P.	Total Iron as Fe.	Copper as Cu.*	pH at Lab
		Total	Susp.	Diss.		Tree Ammonia	Total Kjeldahl	Nitrate	Nitrite				
T28-212		1560	100	1460	910	2.4	*2.5	<.1	.03	*.10	76.	0.11	4.3
T28-211		7700	110	7590	4570	*	*1.5	*	*	*.15	48.	53.7	2.6
T28-210		8000	40	7960	4530	*	*1.5	<.1	.15	*.05	51.	57.0	2.7

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.*	Manganese as Mn.*	Lead as Pb.*	Vanadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-212	0.10	0.03	0.05	1.00	12	1.60	0.0	0.9	0.00	< 1	0.0	0.0
T28-211	150.	2.00	0.18	62.	< 1	27.4	0.0	0.46	0.28	< 1	0.0	0.2
T28-210	160.	1.96	0.15	75.	< 1	26.9	0.0	0.46	0.28	< 1	0.0	0.2

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as A.*	Magnesium as Mg.*	Acidity as $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-212	**	Not Ammenable To. Analysis	0.00	23	8	305.	0.00	18.2	76	2	760
T28-211	**		0.07	87	12	124.	0.03	297	2108	0	2640
T28-210	**		0.05	46	12	129.	0.03	280	2340	0	2520

T28-212 109 - July 13, 1971

T28-211 110 - July 13, 1971

T28-210 111 - July 14, 1971

* Interference due to high iron content

** No method at present

CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

All analyses except pH reported in p.p.m. unless otherwise indicated

1 p.p.m. = 1 mgm. / litre = 1 lb./100,000 Imp Gals

Municipality: Twp. of Robb

Report to: L.E. Olivier, 127 Cedar St., Sudbury, Ont.

c.c.

Source: Kam Kotia Mines Limited

Date Sampled: July 1/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphate as SO_4	NITROGEN		AS	N	Total Phos. as P.	Total Iron as Fe.*	Copper as Cu.*	pH at Lab
		Total	Susp.	Diss.		Free Ammonia	Total Kjeldahl	Nitrate	Nitrite				
T28-209		1510	150	1360	750	0.1	*2.5	<.1	<.01	*.20	68.	0.10	7.6
T28-222		740	30	710	272	1.0	1.3	<.1	.02	.040	15.	0.02	7.6
T28-214		1440	25	1415	840	1.2	1.6	<.1	.02	.06	25..	0.33	3.0

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.*	Manganese as Mn.*	Lead as Pb.*	Vanadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-209	0.59	0.03	0.00	8.90	10	2.81	0.0	0.6	0.00	< 1	0.0	1.0
T28-222	0.05	0.08	0.08	0.12	18	0.43	0.0	0.0	0.00	< 1	0.0	0.04
T28-214	2.39	0.19	0.07	6.10	5	3.22	0.0	0.46	0.00	< 1	0.50	0.0

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as A.*	Magnesium as Mg.*	Acidity as $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-209	**	Not amm- enable to analysis	0.0	24	1.0	290	0.05	56	30	124	860
T28-222	*		0.0	14	7.2	177	0.00	19.5	25	176	464
T28-214	**		0.0	15	6.8	268	0.01	18.0	179	0	710

T28-209 112 - July 1[illegible], 1971

T28-222 113 - July 14, 1971

T28-214 114 - July 13, 1971

* Interference due to high iron content

** No method at present

CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

All analyses except pH reported in p.p.m. unless otherwise indicated

1 p.p.m. = 1 mgm / litr = 1 lb./100,000 Imp. Gal

Municipality: Twp. of Robb

Report to: L.E. Olivier, 127 Cedar St., Sudbury, Ont.

c.c.

Source: Kam Kotia Mines Limited

Date Sampled: July 1/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphate as SO_4	NITROGEN		AS	N	Total Phos. as P.	Total Iron as Fe.*	Copper as Cu.*	pH at Lab
		Total	Susp.	Diss.		Free Ammonia	Total Kjeldahl	Nitrate	Nitrite				
T28-203		1380	15	1365	864	1.3	1.8	<.1	.01	.14	20.	0.26	2.9
T28-217		1690	5	1685	1030	4.6	5.0	<.1	<.01	.17	1.6	0.38	3.1
T28-218		140	5	135	28	0.2	.90	<.1	<.01	.08	0.8	0.02	7.4

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.*	Manganese as Mn.*	Lead as Pb.*	Vanadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-203	1.21	0.10	0.12	4.75	6	1.87	0.0	0.0	0.00	<1	0.0	0.0
T28-217	3.9	0.30	0.07	2.30	43	3.93	0.0	0.0	0.00	<1	0.0	0.0
T28-218	0.14	0.06	0.08	0.20	3	0.22	0.0	0.0	0.00	<1	0.0	0.0

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as A.*	Magnesium as Mg.*	Acidity as $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-203	0.0	<1	0.0	17	8.1	280.	<0.01	1.0	148	0	710
T28-217	**	<1	0.0	44	3.5	262	0.00	74	156	0	890
T28-218	**	Not ammenable to analysis	0.0	2	0.4	23.2	0.00	5.3	2	30	60

T28-203 115 - July 13, 1971

T28-217 116 - July 14, 1971

T28-218 117 - July 14, 1971

* Interference due to high iron content

** No method at present

CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

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1 p.p.m. = 1 mgm. / litre = 1 lb./100,000 Imp. Gals

Municipality: Twp. of Robb

Report to: L.E. Olivier, 127 Cedar St., Sudbury, Ont.

c.c.

Source: Kam Kotia Mines Limited

Date Sampled: July 1/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphate as SO_4	NITROGEN		AS	N	Total Phos. as P.	Total Iron as Fe.*	Copper as Cu.*	pH at Lab
		Total	Susp.	Diss.		Free Ammonia	Total Kjeldahl	Nitrate	Nitrite				
T28-216		150	10	140	<5	0.1	.90	<.1	<.01	.02	0.8	0.03	7.9
T28-219		150	10	140	5	0.1	1.0	<.1	.010	.07	0.5	0.0	7.8
T28-220		140	5	135	5	0.7	.55	<.1	.020	.04	0.5	0.0	7.9

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.*	Manganese as Mn.*	Lead as Pb.*	Vanadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-216	0.00	0.05	0.05	0.58	2	0.12	0.0	0.0	0.00	<1	0.0	0.0
T28-219	0.00	0.03	0.00	0.30	1	0.09	0.0	0.0	0.00	<1	0.0	0.0
T28-220	0.00	0.07	0.02	0.30	1	0.06	0.0	0.0	0.00	<1	0.0	0.04

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as A.*	Magnesium as Mg.*	Acidity as $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-216	**	Not Ammenable to Analysis	0.0	1	0.4	20.7	<0.01	4.3	2	48	50
T28-219	*		0.0	1	0.4	18.2	<0.01	4.3	2	46	50
T28-220	*		0.0	1	0.4	19.5	<0.01	4.5	2	37	52

T28-216 118 - July 13, 1971

T28-219 119 - July 13, 1971

T28-220 120 - July 13, 1971

* Interference due to high iron content

** No method at present

CHEMICAL LABORATORIES

INDUSTRIAL WASTE ANALYSIS

All analyses except pH reported in p.p.m. unless otherwise indicated

1 p.p.m. = 1 mgm. / litr = 1 lb./100,000 Imp. Gal.

Municipality: Twp. of Robb

Source: Kam Kotia Mines Limited

Report to: L.E. Olivier, 127 Cedar St., Sudbury, Ont.

c.c.

Date Sampled: July 1/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphate as SO_4	NITROGEN		AS	N	Total Phos. as P.	Total Iron as Fe.*	Copper as Cu.*	pH at Lab
		Total	Susp.	Diss.		Free Ammonia	Total Kjeldahl	Nitrate	Nitrite				
T28-205		150	10	140	28	0.3	.65	<.1	.04	.030	0.8	0.04	7.9
T28-206		160	10	150	25	0.1	.90	<.1	.01	.040	0.4	0.0	7.8
T28-225		130	5	125	155	0.2	.80	<.1	.04	.040	1.0	0.05	7.2

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.*	Manganese as Mn.*	Lead as Pb.*	Vanadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-205	0.15	0.06	0.04	0.28	3	0.15	0.0	0.0	0.00	<1	0.0	0.0
T28-206	0.10	0.02	0.00	0.10	3	0.11	0.0	0.0	0.00	<1	0.0	0.0
T28-225	0.10	0.02	0.00	0.20	5	0.12	0.0	0.0	0.00	<1	0.0	0.0

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as A.*	Magnesium as Mg.*	Acidity as $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-205	**	Not amenable to analysis	0.0	2	0.6	21.8	0.00	5.7	6	30	60
T28-206	**		0.0	2	0.6	20.0	0.00	4.4	6	32	60
T28-225	*		0.0	3	0.7	23.6	0.00	5.9	1	34	64
		<1									

T28-205 124- July 14, 1971

T28-206 125 - July 14, 1971

T28-225 126 - July 14, 1971

* Test performed on preserved sample

** No method at present

All analyses except pH reported in p.p.m. unless otherwise indicated

INDUSTRIAL WASTE ANALYSIS

1 p.p.m = 1 mgm. / litre
= 1 lb./100,000 Imp. Gals.

Municipality: Twp. of Robb

Report to: L.E. Olivier, 127 Cedar St., Sudbury, Ont.

c.c.

Source: Kam Kotia Mines Limited

Date Sampled: July 1/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			Sulphate as SO_4	NITROGEN		AS	N	Total Phos. as P.	Total Iron as Fe.*	Copper as Cu.*	pH at Lab
		Total	Susp.	Diss.		Free Ammonia	Total Kjeldahl	Nitrate	Nitrite				
T28-213		160	5	155	6	0.2	.80	<.1	.02	.04	1.3	0.01	7.6
T29-18		110	10	100	11	2.0	2.0	200	.20	.10	0.28	0.0	8.1
T29-19		80	5	75	11	1.0	1.3	190	.03	.10	0.26	0.0	8.2

Lab. No.	Zinc as Zn.*	Cobalt as Co.*	Nickel as Ni.*	Aluminum as Al.*	Chloride as Cl.*	Manganese as Mn.*	Lead as Pb.*	Varadium as V.*	Cadmium as Cd.*	Mercury as Hg.*	Tin as Sn.*	Titanium as Ti.*
T28-213	0.00	0.04	0.04	0.44	2	0.17	0.0	0.0	0.00	<1	0.0	0.0
T29-18	0.0	0.0	0.0	0.40	7	0.02	0.0	0.0	0.0	<1	0.50	0.0
T29-19	0.0	0.0	0.0	0.35	3	0.03	0.0	0.0	0.0	<1	0.0	0.0

Lab. No.	Molybdenum as Mo.*	Barium as Ba	Lithium as Li.*	Sodium as Na.	Potassium as K.	Calcium as Ca.*	Arsenic as A.*	Magnesium as Mg.*	Acidity as $CaCO_3$	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$
T28-213	**	Not Ammenable to Analysis	0.0	1	0.4	20.9	0.00	4.2	6	42	50
T29-18	**	<1	0.01	3	0.6	10.4	0.0	3.1	4	32	48
T29-19	**	<1	0.01	2	0.5	14.7	0.0	3.2	6	32	48

T28-213 121 - July 13, 1971

T29-18 122 - July 14, 1971

T29-19 123 - July 14, 1971

* Interference due to high iron content

** No method at present

All analyses except pH reported in p.p.m. unless otherwise indicated

INDUSTRIAL WASTE ANALYSIS

1 p.p.m. = 1 mgm. / litre
= 1 lb./100,000 Imp. Gals.

Municipality: Township of Robb

Source: Kam-Kotia Mines Limited

Report to: L.E. Olivier,
127 Cedar St..,
Sudbury, Ontario

c.c.

Date Sampled: April 26/71 by: L.E. Olivier

Lab. No.	5-Day B.O.D.	Solids			pH	Copper as Cu	Zinc as Zn	Iron as Fe	Sulphate as SO_4				
		Total	Susp.	Diss.									
T18-52		1230	30	1200	3.0	0.78	9.2	20.	762				
T18-54		1100	50	1050	2.9	1.1	9.5	36.	572				

T18-52 127 - Effluent into Lake Kamiskotia (via Highway 576 culvert)

T18-54 128 - Effluent into Little Kamiskotia River (via Highway 576 ditch)

10M-60-22690

ACKNOWLEDGMENTS

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(8) M. McKenney; Internal Memorandum , "Ownership and and Responsibility of Kam-Kotia and Jameland Mines" (1975)

(9) C. R. Gibson; Internal Memorandum and Correspondence, "Ownership of the Kam-Kotia Mining Claims" (1975)

APPENDIX

THE ORIGIN OF WATER POLLUTION PROBLEMS

The sources of water borne contaminants released from mining and milling operations, can be classified into two distinct groups: acid generated from the exposure of iron sulphide minerals to the atmosphere; and, contaminants which result from the mining and processing of the ore.

ACID GENERATION

THE BASIC MECHANISMS

Acid mine waters are producted from the oxidation of sulphide minerals particularly those containing iron. Actually, in theory, the acid mine waters can occur either chemically or biologically. Dealing with the biological side, the bacterium thiobacillus ferrooxidans is always present in acid mine waters.

Thiobacillus ferrooxidans is a bacterium which grows at a rapid rate from the oxidation of sulphur compounds (reduced). In order to perform oxidation of the reduced sulphur compounds, the bacterium requires the following: carbon dioxide, water, oxygen, ammonia, phosphorus, calcium, and magnesium (the former three are found in sufficient quantities in natural waters).

The acid generation process is illustrated by considering the example of pyrite.

$$4\ FeS_2 + 15\ O_2 + 14\ H_2O \longrightarrow 4\ Fe(OH)_3 + 8H_2\ SO_4 \quad (1).$$

The above reaction, represents complete hydrolysis of all the

ferric iron, thus producing two moles of sulphuric acid per mole of pyrite. In all practical aspects, not all the iron precipitates as iron hydroxide, but rather in a form as an iron sulphate jarosite.

This is represented by $AFe_3(SO_4)_2(OH)_6$, where A can be any of the alkali metals or a hydrogen ion. This can be shown in the following way;

$6\ FeS_2 + 22\frac{1}{2}\ O_2 + 15H_2O \longrightarrow 2HFe_3(SO_4)_2(OH)_6 + 8H_2SO_4$ (2)

thus 1.33 moles of acid are produced.

Considering side reactions that can take place, the previous two equations, in practice, do not produce 2 and 1.33 moles respectively; but the amount produced lies somewhere between them.

A similar reaction can take place in the oxidation of chalcopyrite ($CuFeS_2$).

$CuFeS_2 + 4O_2 + 2H_2O \longrightarrow CuSO_4 + Fe(OH)_2 + H_2SO_4$

(3) $6\ CuFeS_2 + 25\frac{1}{2}\ O_2 + 9H_2O \longrightarrow 6\ CuSO_4 + 2\ HFe_3(SO_4)_2(OH)_6 + 2H_2SO_4$ (4)

There are three major reactions involved in the oxidation of iron.

Reaction #1 - When iron (pyrite) sulphide oxidies in the presence of water or water vapour, sulphuric acid and ferrous sulphate are equal end products eg.;

$2FeS_2 + 2H_2O + 7O_2 \longrightarrow 2\ FeSO_4 + 2H_2SO_4$ (5) Iron sulphide + water + oxygen ferrous sulphate + sulphuric acid.

Reaction #2

This reaction is the oxidation of iron from the ferrous state to the ferric state.

$4\ FeSO_4 + 2H_2\ SO_4 + O_2 \longrightarrow 2Fe\ (SO_4)_3 + 2H_2O$ (6)

Ferrous sulphtate + sulphuric acid + oxygen $\longrightarrow$ ferric sulphate + water.

Reaction #3

The precipitation of iron is quite evident in this reaction

$Fe_2(SO_4)_3 + 6H_2O \longrightarrow 2\ Fe\ (OH)_3 + 3\ H_2SO_4$ (7)

Ferric sulphate + water $\longrightarrow$ ferric hydroxide + sulphuric acid

The ferric ion accelerates the acid forming process by the oxidation of further amounts of sulphuritic materials.

$Fe_2(SO_4)_3 + FeS_2 + H_2O \longrightarrow 3\ FeSO_4 + 2S$

Ferric sulphate + iron sulphide + water $\longrightarrow$ ferrous sulphate + sulphur (8)

$S + 30 + H_20 \longrightarrow H_2SO_4$ (9)

sulphur + oxygen + water $\longrightarrow$ sulphuric acid

Under certain conditions, the oxidation of iron sulphides can introduce partially oxidized substances. These are sulphur compounds such as sulphites and thiosulphites. These can be oxidized by polythionates and eventually sulphuric acid.

$S_20_3 \longrightarrow SnO_6 \longrightarrow S306 \longrightarrow H_2SO_4$ (10)

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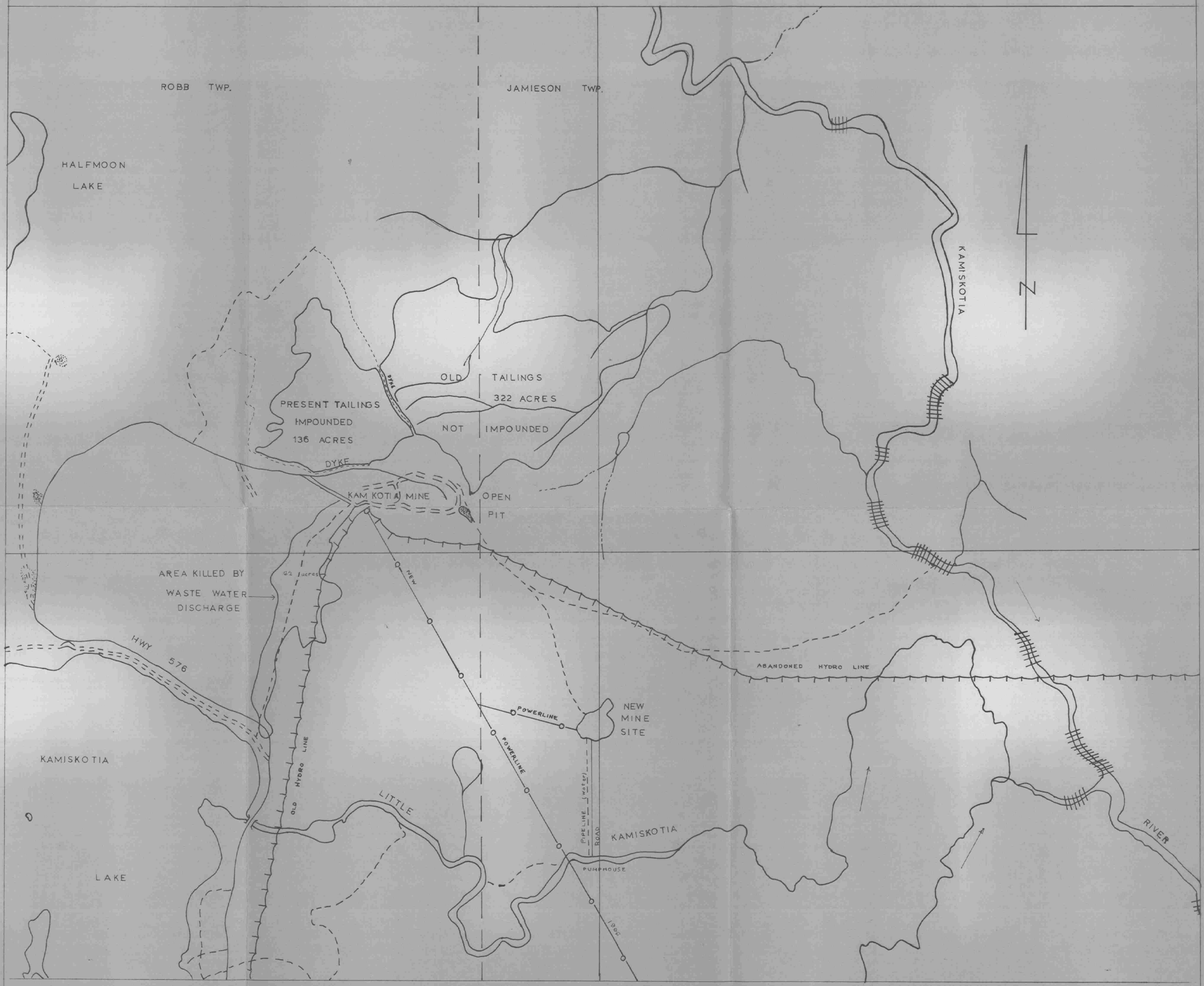

KAM KOTIA JAMELAND MINE AND AREA

1976

SCALE: 4 INCHES = 1 MILE